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REPORT

S. P. LANGLEY

JUNE 30 1893

REPORT

OF

S. P. LANGLEY,

SECRETARY OF THE SMITHSONIAN INSTITUTION

FOR THE

YEAR ENDING JUNE 30, 1893.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1894.

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REPORT OF S. P. LANGLEY,
SECRETARY OF THE SMITHSONIAN INSTITUTION,
FOR THE YEAR ENDING JUNE 30, 1893.

To the Board of Regents of the Smithsonian Institution:

GENTLEMEN: I have the honor to submit herewith a report of the operations of the Smithsonian Institution for the year ending June 30, 1893, including the work placed by Congress under its supervision in the National Museum, the Bureau of Ethnology, the Bureau of International Exchanges, the Zoölogical Park, and the Astro-Physical Observatory.

I have endeavored to give in the body of the report, and as briefly as possible, a general account of the affairs of the Institution for the year, reserving for the appendix the more detailed and statistical reports from the officers in charge of the different branches of work.

The report upon the National Museum by the Assistant Secretary, Dr. G. Brown Goode, is here given only in abstract. Its full presentation occupies a separate volume. (Report of the Smithsonian Institution, National Museum, 1893.)

THE SMITHSONIAN INSTITUTION.

THE ESTABLISHMENT.

Since the change of executive officers of the United States Government on March 4, 1893, the Smithsonian establishment consists of the following *ex officio* members:

GROVER CLEVELAND, *President of the United States.*

ADLAI E. STEVENSON, *Vice-President of the United States.*

MELVILLE W. FULLER, *Chief Justice of the Supreme Court of the United States.*

WALTER Q. GRESHAM, *Secretary of State.*

JOHN G. CARLISLE, *Secretary of the Treasury.*

DANIEL S. LAMONT, *Secretary of War.*

HILARY A. HERBERT, *Secretary of the Navy.*

WILSON S. BISSELL, *Postmaster-General.*

RICHARD OLNEY, *Attorney-General.*

JOHN S. SEYMOUR, *Commissioner of Patents.*

The Hon. W. E. Simonds was succeeded on April 16, 1893, as Commissioner of Patents by the Hon. John S. Seymour.

THE BOARD OF REGENTS.

In accordance with a resolution of the Board of Regents adopted January 8, 1890, by which its stated annual meeting occurs on the fourth Wednesday in each year, the board met on January 25, 1893, at 10 o'clock A. M. The journal of its proceedings will be found, as hitherto, in the annual report of the board to Congress, though reference is here made to several matters upon which action was taken at this meeting.

The changes that have taken place in the membership of the Board of Regents have been—

First, through the death of Senator R. L. Gibson, which occurred on December 15, 1892. Senator George Gray, of Delaware, was appointed on December 20, 1892, by the Vice-President to fill the unexpired term of Senator Gibson, and having been re-elected as Senator from Delaware, was re-appointed Regent on March 16, 1893.

A brief sketch of Senator Gibson's life is given in the necrological notices that close the present report, but I may quote here the following resolutions prepared by a committee consisting of Dr. Wm. Preston Johnston, Senator J. S. Morrill, and the Secretary, which were presented at the meeting of the Regents on January 25, 1893:

Resolved, That in the death of Hon. Randall Lee Gibson, the Smithsonian Institution has lost a zealous and useful Regent, and its board a valuable member whose services can ill be spared.

Resolved, That we lament his loss as an acceptable colleague, a gracious gentleman, a patriotic citizen, and a wise statesman, whose interest in the spread of knowledge among men fitted him well for his duties on the board.

Resolved, That these resolutions be entered on the minutes of the board, and a copy be transmitted to the family of our friend.

Second, President James B. Angell, of the University of Michigan, whose previous term of office expired on January 13, 1893, was reappointed for six years by a joint resolution introduced by Senator J. S. Morrill, of Vermont, which passed the Senate on December 20, 1892, the House of Representatives on January 6, 1893, and was approved by the President January 10, 1893.

ADMINISTRATION.

I have called attention to the desirability of securing from Congress an appropriation to meet actual outlays incurred in administering Governmental trusts. These direct outlays for matters not equitably chargeable to the fund of James Smithson, are growing a more considerable tax upon it each year. They are incurred in serving purely Governmental interests, but they are not met by any of the present appropriations, since they belong not singly to the National Museum, or the Bureau of Ethnology, or to the International Exchange service, or the like, but to expenditures common to all of them, and which are not provided for by the terms of the appropriations for any one.

It is in the interests of economy that this expenditure should be met from some common source, owing to the limited size of the establishments in question, some of which are rather assimilable to divisions than to bureaus. It is evident, for instance, that an appropriation of \$17,000 for international exchanges, or an appropriation of \$10,000 for an observatory, can not each so well bear the separate provision of a disbursing officer, a stenographer, and the other like employés, as in the case of larger bureaus, but that their limited needs can be better and more economically managed by not duplicating such offices. There is, however, no practicable way of arranging this in compliance with the present terms of the appropriations, which may be said to tacitly assume that each of these bureaus or divisions is thus completely provided for.

It is in some cases impossible that it should be so without the expenditure of greatly more than the appropriated sum, and the terms of the appropriations should in the interest of economy, either recognize the propriety of meeting each bureau's share of these common expenses out of each one's appropriation, or else out of a special appropriation made in their common interest.

FINANCES.

The permanent funds of the Institution remain the same as at the time of my last report, and are as follows:

Bequest of Smithson, 1846	\$515, 169. 00
Residuary legacy of Smithson, 1867	26, 210. 63
Deposits from savings of income, 1867	108, 620. 37
Bequest of James Hamilton, 1875	1, 000. 00
Bequest of Simeon Habel, 1880	500. 00
Deposits from proceeds of sale of bonds, 1881	51, 500. 00
Gift of Thomas G. Hodgkins, 1891	200, 000. 00
Total permanent fund	903, 000. 66

This sum of \$903,000 is deposited in the Treasury of the United States, and by act of Congress bears interest at 6 per cent per annum, the interest alone being used in carrying out the aims of the Institution.

At the beginning of the fiscal year, July 1, 1892, the balance on hand was \$47,875.33. Interest on the invested funds, amounting to \$54,180, was received during the year, which, together with a sum of \$3,792.54, received from the sale of publications, and from miscellaneous sources, made the total receipts \$57,972.54.

The total expenditure during the year was \$48,755.05, for the details of which reference is made to the report of the executive committee. The unexpended balance on June 30, 1893, was \$57,092.82, which includes the sum of \$10,000 referred to in previous reports, \$5,000 having been received from the estate of Dr. Kidder, and a like sum from Dr. Alexander Graham Bell, the latter a gift made personally to the Secretary to promote certain physical investigations.

This latter sum was, with the donor's consent, deposited by the Secretary to the credit of the current funds of the Institution.

This \$10,000 is not, then, a portion of the invested funds, but is held partly to erect a building whenever Congress shall provide a site for a permanent Astrophysical Observatory, and partly to meet anticipated expenditures in certain investigations.

This balance also includes the interest accumulated on the Hodgkins donation and on the Hamilton fund, which is awaiting the Regents' disposition, besides certain relatively considerable sums held to meet obligations which may be expected to mature as the result of different scientific investigations or publications in progress.

The Institution has been charged with the disbursement, during the fiscal year 1892-'93, of the following appropriations:

For international exchanges.....	\$17, 000
For North American Ethnology	40, 000
For U. S. National Museum:	
Preservation of collections.....	134, 500
Furniture and fixtures.....	15, 000
Heating and lighting.....	13, 000
Postage	500
For National Zoological Park	50, 000
For Astrophysical Observatory	10, 000

All vouchers and checks for the disbursements have been examined by the executive committee, and the expenditures will be found reported in accordance with the provisions of the sundry civil act of October 2, 1888, in a letter addressed to the Speaker of the House of Representatives.

The vouchers for all the expenditures from the Smithsonian fund proper have been likewise examined and their correctness certified to by the executive committee, whose statement will be published together with the accounts of the funds appropriated by Congress, in that committee's report.

The estimates for the fiscal year ending June 30, 1894, for carrying on the Government interests under the charge of the Smithsonian Institution, were as follows:

International exchange	\$23, 000
North American Ethnology.....	50, 000
National Museum:	
Preservation of collections.....	180, 000
Heating and lighting	15, 000
Furniture and fixtures.....	30, 000
Postage	500
Galleries	8, 000
National Zoological Park	75, 000
Astrophysical Observatory	10, 000
Building, Smithsonian Institution	5, 000

With regard to the general expenditures of the Institution, it may be remarked that those for clerical services and for incidental expen-

ses have for the last seven years, owing to increasing economies, been diminishing until they are now considerably less in proportion to the amount administered than at any former time. It is doubtful whether these economies can be advantageously pushed any further, as it has become difficult, with the present force, to keep abreast of the actual current demands, and there has been no considerable renewal of the perishable furnitures of the building during the period mentioned. It seems probable, therefore, that the proportionate cost of these items is not likely to be again lower than it is at present.

BUILDINGS.

It may perhaps seem superfluous, in consideration of the serious reductions that have been made in the appropriations for the current expenses of the Museum, to repeat my recommendation that more adequate accommodations should be provided for it by the erection of a new and thoroughly fireproof building, but while this is needed for many reasons, the repetition is opportune now, since valuable material may come to the Museum at the close of the World's Columbian Exposition in Chicago, and because if there are storage and exhibition rooms available, many exhibits at Chicago may be secured, which it will otherwise perhaps be necessary to refuse.

I must repeat what I have stated in previous reports, that since the present Museum building was finished and occupied in 1881, the collections have increased to such an extent that a new building quite as large as the present one could have been advantageously filled, and that the need grows yet more pressing.

The improvement of buildings in the Zoological Park to the limited extent that the appropriations allowed, is detailed in the report of the acting manager.

REPAIRS TO THE SMITHSONIAN BUILDING.

A restrictive clause contained in the appropriation of August 30, 1890, for repairs to the Smithsonian building was removed by a clause in the sundry civil act for the year ending June 30, 1894, so that a portion of the amount unexpended became available for making necessary repairs to the roof of the eastern wing and improving the sanitary condition of the building, as well as for increasing the space available for storing documents and handling the Government exchanges. The plumbing in the eastern part of the building has been thoroughly overhauled, and a suite of dark and damp rooms in the basement on the south side has been transformed into well-lighted and comfortable offices, thus freeing several rooms upon the first floor, needed for other purposes, and making it possible to handle more expeditiously the great number of books passing through the exchange office; though even with these new rooms, additional storeroom for the Government exchanges will be called for at no distant day.

It may be of interest to note that a mark was placed, by my direction, at the side of the window of the northeast corner room in the basement of the Smithsonian building, 31 feet above the datum plane used by the engineer office of the District of Columbia, situated at the corner of Fifteenth and B streets NW., or about 19.87 feet above the highest flood mark recorded, that of June 2, 1889.

RESEARCHII.

It appears to be an essential portion of the original scheme of the government of the Institution that its Secretary should be expected to advance knowledge, whether in letters, or in science, by personal research; and resolutions of the Regents formally request the Secretary to continue his investigations in physical science, and to present their results for publication in the Smithsonian "Contributions."

The advancement of science through original research at the hands of those eminent men, Henry and Baird, the former Secretaries of this Institution, is known to all, but though the Secretary may be still expected to personally contribute to the advancement of science, or art, or letters, by his individual efforts, it is certain that the increasing demands of time for labors of administration had greatly limited the possibility of this, even in the time of Henry, and that at the present day administrative duties, and especially those connected with the care of Government interests, constitute a barrier to such investigations, which is all but impassable.

I have never abandoned, however, the hope to thus continue the tradition of the Institution and the usage of former Secretaries by personally contributing, as far as I could, to the objects stated, and I have, where administrative duties would permit, continued during the present year the researches, of which a portion has been published, in August, 1891, in a treatise entitled "Experiments in Aerodynamics." Interesting results have since been reached here, which appear to be of wide utilitarian importance, but though I trust, before the close of another year, to be able to make some communication of them to the public, they are not yet complete.

In this same connection, in pursuit of an investigation begun some years ago, and in continuation of the Institution's interest in the promotion of meteorological studies, I have made experiments upon the variations continually going on in the atmosphere, in what is regarded for ordinary meteorological purposes as a steady wind. Specially light anemometers have been constructed and mounted upon the north tower of the Smithsonian building, and connected with a suitable recording apparatus. The results, which promise conclusions of practical importance, are being collated and will be published at a later date. I am under obligations to the Chief of the U. S. Weather Bureau for the loan of a portion of these anemometers, the others having been constructed in the small workshop of the Institution.

I have continued to give what time and thought I can to investigations in astro-physics, which are so extensive and, I hope, so important, as to justify a considerable separate mention under the title, *Astro-physical Observatory*, in the Appendix of this report.

In what I have said I have principally referred to research in the physical sciences, since aid to original research in the biological sciences has been largely, though indirectly, provided through the Institution's connection with the National Museum and otherwise. It would, therefore, seem proper that what aid to scientific men can be given from the original Smithsonian fund should be principally devoted to the physical sciences, which are not otherwise cared for.

As in previous years, aid to a limited extent has been given to original investigators who are not immediately connected with the Institution. Prof. E. W. Morley has continued his determinations of the density of oxygen and hydrogen, for which special apparatus has been provided by the Institution.

A paper by Prof. A. A. Michelson, upon the "Application of interference methods to spectroscopic measurements," with a view to increased precision in measuring specific wave-lengths of light, has been published in connection with his work upon a universal standard of length. Mr. F. L. O. Wadsworth was detached from the Observatory staff, and sent (at the expense of the Smithsonian fund) to the Bureau Internationale des Poids et Mesures near Paris to assist Prof. Michelson during a stay of six weeks in the preparation of this standard.

Prof. Holden, the director of the Lick Observatory, Mount Hamilton, Cal., is still engaged in lunar photography, for which some occasional aid has been given in previous years by the Institution.

The subscription for twenty copies of the *Astronomical Journal*, which are distributed abroad as exchanges of the Institution, has been continued.

In the *Astro-physical Observatory* the investigations of radiant energy alluded to in my previous reports have been continued, and very interesting results have been obtained. I have referred, on another page, somewhat at length to the work of the Observatory, and further details are contained in the report in the Appendix.

The Hodgkins researches have already promised to assume such importance that they have also been given a special place upon a later page of the present report.

EXPLORATIONS.

I am much gratified to report the safe return of Mr. W. W. Rockhill from his dangerous journey in Tibet. His explorations have added much to our knowledge of these regions, and a portion of the collection he has made will eventually be placed in the National Museum. Mr. Rockhill is now engaged upon the preparation of a special report of

his journey, which will be published in the Miscellaneous Collections of the Institution, while a brief popular abstract of his paper is now in print and will form a part of the Appendix to the Annual Report of the Regents for the year ending June 30, 1892, soon to be issued.

The principal other explorations of the Institution have been made through the Bureau of Ethnology, to the report of whose Director the reader is referred.

PUBLICATIONS.

Smithsonian Contributions to Knowledge.—The quarto series of publications under this title, inaugurated by the Institution in 1848, has always been regarded as the most important of its issues—not merely by priority in date, but as including only memoirs of extended original investigations and researches, advancing what are believed to be new truths, and constituting therefore positive additions to human knowledge.

The hope of its originator—the first Secretary—to be able to send forth a quarto volume annually (after the practice of the Royal Society of London), has not been realized; partly from the insufficiency of material presented judged worthy of the position, partly from the cost.

Volume XXXVIII of the “Contributions to Knowledge” has been issued during the year, consisting entirely of a memoir entitled “Life Histories of North American Birds, with special reference to their breeding habits and eggs,” by Capt. Charles E. Bendire (U. S. Army, retired), honorary curator of the oölogical collections in the U. S. National Museum. This somewhat elaborate work is illustrated with well-executed chromo-lithographic plates of birds’ eggs, representing eight families and over 100 different species. It has been received with exceptional favor by European as well as by American men of science.

Another memoir published during the year, which, though brief, is regarded as an important scientific “contribution,” is a discussion, by Prof. A. A. Michelson, of “the application of interference methods to spectroscopic measurements,” with a view to an increased precision in measuring specific wave-lengths of light, which may ultimately be employed as fixed standards of comparison for units of linear metrology.

Smithsonian Miscellaneous Collections.—Of this series two volumes have been issued during the year, Volumes XXXIV and XXXVI, the former comprising a collection of ten articles previously published separately.

The latter consists of a new bibliography of chemistry for the past four hundred years, a work of remarkable research by Dr. Henry Carington Bolton, extending to more than 1,200 octavo pages.

Volume XXXV of this series has not yet been completed, though the first contribution thereto has been issued, namely, a volume of “Smithsonian meteorological tables” of over 300 pages. It forms the first of three projected volumes of tables—(A) meteorological, (B) geograph-

ical, (C) physical—designed to supersede the tables of Dr. Guyot, first published by this Institution in 1852, which have had so wide and so useful a currency, but which are now so far out of date that it seems better to replace than to revise and reprint them.

Smithsonian Annual Reports.—The report of the U. S. National Museum to the Secretary of the Smithsonian Institution for the year ending June 30, 1890, has only been received from the printer this year. The Smithsonian Report for the year ending June 30, 1891, as well as the Museum Report for the same period, have not yet been received from the Government Printing Office.

Reports of the Bureau of Ethnology.—The Seventh Annual Report of the Director of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, published during the year, maintains the usual character of excellence.

LIBRARY.

The plan detailed in my report for 1887-'88 for increasing the accessions to the library and for completing the series of scientific journals already in possession of the Institution has been continued, with gratifying results. Since the plan was first put in operation 1,350 new periodicals have been added to the list and 909 defective series have been either completed or filled out as far as the publishers were able to supply missing parts.

The reading room no longer has sufficient accommodations for the growing exchanges of the Institution, nor for the persons desiring to consult this important collection of current scientific literature.

Ever since 1890 I have called attention in my reports to the fact that the present quarters of the library are insufficient, the natural expansion of the library having been prevented by the fact that the rooms adjacent to it were occupied by the international exchanges. It will be possible shortly to assign other quarters to the exchanges, and plans have been prepared for book shelves and a gallery in one of the rooms made vacant. It is estimated that space will thus be secured for about 6,000 volumes.

Mr. John Murdoch, whose resignation as librarian was referred to in my last report, was succeeded in charge of the library on July 16, 1892, by Mr. J. Elfreth Watkins.

Mr. Watkins on October 1, 1892, resigned his position, and on December 1, 1892, Dr. Cyrus Adler, of the Johns Hopkins University, was appointed to fill the vacancy. Dr. Adler's report on the library for the year is given in Appendix IV.

The Institution has possessed for many years a number of costly illustrated works of art, engravings and etchings, which were acquired by the Regents, by purchase, of the late Mr. Marsh, our minister at Rome. These were understood to have been temporarily deposited with the Library of Congress for safekeeping in 1874. Some correspondence

with regard to them took place between the Secretary and the Librarian on May 10 of the present year, from which it appears that the bound volumes are, in general, accessible, but that a large portion of the unbound engravings which the catalogue—an imperfect one,—appears to call for,—can not at present be found, nor is it, indeed (owing to the imperfection of the present catalogue and lists), yet certain that all of these were in fact sent to the Library of Congress.

I mention in connection with the expression of the interest that the Institution is intended to take in art, the fact that the Regents, at their meeting of October, 1891, having instructed the Secretary to cause to be painted a portrait of Mr. Hodgkins, he placed the execution of this in the hands of Mr. Robert Gordon Hardie, who produced (though aided only by a photograph and a description given by friends) a portrait of Mr. Hodgkins both valuable as a work of art and singularly true as a likeness. This was submitted to the Regents at their meeting in January, and received their general approbation.

In this same connection it may be observed that the portrait of Henry, executed by the Regents' instructions in former years, was sent to form a portion of the Smithsonian exhibit at the World's Fair in Chicago.

THE HODGKINS FUND.

As stated in the Secretary's Report for 1892, the gift to the Smithsonian Institution of \$200,000 by Mr. Thomas George Hodgkins, of Setauket, N. Y., was formally accepted at a special meeting of the Board of Regents on the 21st of October, 1891.

On the 23d of the same month Mr. Hodgkins added to his will a codicil making the Smithsonian Institution his residuary legatee, but the sum thus added to the original gift will not, it is understood, be considerable.

The committee appointed to advise upon matters connected with the Hodgkins foundation* submitted the following circular, which was approved, and published in March, 1892, and has since then been widely distributed, more than 8,000 copies having been sent throughout the world to learned institutions and to investigators, and, on request, to all expressing themselves interested in the researches which, in accordance with the wish of the founder, it is the design to have specially furthered by the income from the Hodgkins fund.

SMITHSONIAN INSTITUTION.

[Presiding officer *ex officio*: The President of the United States. Chancellor: The Chief Justice of the United States. All correspondence should be addressed to the secretary, S. P. Langley.]

CIRCULAR CONCERNING THE HODGKINS FUND PRIZES.

In October, 1891, Thomas George Hodgkins, Esq., of Setauket, N. Y., made a donation to the Smithsonian Institution, the income from a part of which was to be devoted "to the increase and diffusion of more

See Secretary's Report for 1892, p. 20.

exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man."

With the intent of furthering the donor's wishes, the Smithsonian Institution now announces the following prizes, to be awarded on or after July 1, 1894, should satisfactory papers be offered in competition:

(1) A prize of \$10,000 for a treatise embodying some new and important discovery in regard to the nature or properties of atmospheric air. These properties may be considered in their bearing upon any or all of the sciences, e. g., not only in regard to meteorology, but in connection with hygiene, or with any department whatever of biological or physical knowledge.

(2) A prize of \$2,000 for the most satisfactory essay upon (a) the known properties of atmospheric air, considered in their relationships to research in every department of natural science, and the importance of a study of the atmosphere, considered in view of these relationships; (b) the proper direction of future research, in connection with the imperfections of our knowledge of atmospheric air, and of the connections of that knowledge with other sciences.

The essay, as a whole, should tend to indicate the path best calculated to lead to worthy results in connection with the future administration of the Hodgkins foundation.

(3) A prize of \$1,000 for the best popular treatise upon atmospheric air, its properties and relationships (including those to hygiene, physical and mental). This essay need not exceed 20,000 words in length; it should be written in simple language, and be suitable for publication for popular instruction.

(4) A medal will be established, under the name of *The Hodgkins Medal of the Smithsonian Institution*, which will be awarded annually or biennially, for important contributions to our knowledge of the nature and properties of atmospheric air, or for practical applications of our existing knowledge of them to the welfare of mankind. This medal will be of gold, and will be accompanied by a duplicate impression in silver or bronze.

The treatises may be written in English, French, German, or Italian, and should be sent to the Secretary of the Smithsonian Institution, Washington, before July 1, 1894, except those in competition for the first prize, the sending of which may be delayed until December 31, 1894.

The papers will be examined and prizes awarded by a committee to be appointed as follows: One member by the Secretary of the Smithsonian Institution; one member by the president of the National Academy of Sciences; one by the president *pro tempore* of the American Association for the Advancement of Science; and the committee will act together with the secretary of the Smithsonian Institution as member *ex officio*. The right is reserved to award no prize if, in the judgment of the committee, no contribution is offered of sufficient merit to warrant an award. An advisory committee of not more than three European men of science may be added at the discretion of the committee of award.

If no disposition be made of the first prize at the time now announced the Institution may continue it until a later date, should it be made evident that important investigations relative to its object are in progress, the results of which it is intended to offer in competition for the prize. The Smithsonian Institution reserves the right to limit or modify the conditions for this prize after December 1, 1894, should it be found necessary. Should any of the minor prizes not be awarded to papers sent in before July 1, 1894, the said prizes will be withdrawn from competition.

A principal motive for offering these prizes is to call attention to the Hodgkins fund and the purposes for which it exists, and accordingly this circular is sent to the principal universities, and to all learned societies known to the Institution, as well as to representative men of science in every nation. Suggestions and recommendations in regard to the most effective application of this fund are invited.

It is probable that special grants of money may be made to specialists engaged in original investigation upon atmospheric air and its properties. Applications for grants of this nature should have the indorsement of some recognized academy of sciences or other institution of learning, and should be accompanied by evidences of the capacity of the applicant in the form of at least one memoir already published by him, based upon original investigation.

To prevent misapprehension of the founder's wishes it is repeated that the discoveries or applications proper to be brought to the consideration of the committee of award may be in the field of any science or any art without restriction; provided only that they have to do with "the nature and properties of atmospheric air in connection with the welfare of man."

Information of any kind desired by persons intending to become competitors will be furnished on application.

All communications in regard to the Hodgkins fund, the Hodgkins prizes, the Hodgkins medals, and the Hodgkins fund publications, or applications for grants of money, should be addressed to S. P. Langley, Secretary of the Smithsonian Institution, Washington, U. S. A.

[SEAL.]

S. P. LANGLEY,

Secretary of the Smithsonian Institution.

Washington, March 31, 1893.

Some desire being expressed for a more explicit declaration of the scope of the investigations permitted by the Hodgkins foundation, the following supplementary circular was issued in April, 1893, in further explanation of the purport of the donor's intentions:

SMITHSONIAN INSTITUTION.

HODGKINS PRIZES.

WASHINGTON, *April, 1893.*

In answer to inquiries and in further explanation of statements made in the Hodgkins circular, it may be added that any branch of natural science may offer a subject of discussion for the Hodgkins prizes, where this subject is related to the study of the atmosphere in connection with the welfare of man.

Thus, the anthropologist may consider the history of man as affected by climate through the atmosphere; the geologist may study in this special connection the crust of the earth, whose constituents and whose form are largely modified by atmospheric influences; the botanist, the atmospheric relations of the life of the plant; the electrician, the atmospheric electricity; the mathematician and physicist, problems of aërodynamics in their utilitarian application; and so on through the circle of the natural sciences, both biological and physical, of which there is perhaps not one which is necessarily excluded.

In explanation of the donor's wishes, which the Institution desires scrupulously to observe, it may be added that Mr. Hodgkins illus-

trated the catholicity of his plan by citing the experiments of Franklin in atmospheric electricity, and the work of the late Paul Bert upon the relations of the atmosphere to life, as subjects for research, which, in his own view, might be properly considered in this relationship.

While the wide range of the subjects which the founder's purpose makes admissible can not be too clearly stated, it is equally important to emphasize the fact that the prizes in the different classes can be awarded only in recognition of distinguished merit.

S. P. LANGLEY,
Secretary.

Numerous applications, which are referred to the advisory committee for consideration, have already been made for grants from the fund to aid original investigations upon the nature of atmospheric air and its properties. Two have been approved, a grant of \$500 having been made to Dr. O. Lummer and Dr. E. Pringsheim, members of the Physical Institute of the Berlin University, for researches on the determination of an exact measure of the cooling of gases while expanding, with a view to revising the value of that most important constant which is technically termed the "gamma" function. Drs. Lummer and Pringsheim were recommended for this work by the eminent professor, Dr. H. von Helmholtz, of Berlin.

A second grant of \$1,000 has been made to Dr. J. S. Billings, U. S. A., Army Medical Museum, Washington, and to Dr. Weir Mitchell, of Philadelphia, for an investigation into the nature of the peculiar substances of organic origin contained in the air expired by human beings, with a specific reference to the practical application of the results obtained to the problem of ventilation for inhabited rooms.

It is the intention that all applications for special grants shall be thoroughly weighed by the committee first appointed, one of whose functions it is to advise upon matters of this nature. They will then be referred to the second, or committee of adjudication, for final action, which shall be reached only after a comparative estimate of the value of the researches proposed, and their relation to the object for which the Hodgkins fund was established.

Numerous papers have already been submitted in competition for the prizes, all of which will be carefully examined and passed upon by the committees before a final decision as to their merit can be reached.

The Secretary has under advisement the designs for the medal established in connection with the Hodgkins competition, and which it has been determined to award annually or biennially.

The death of Mr. Hodgkins occurred on the 25th of November, 1892, when he had reached the age of nearly 90 years. In this event the Institution lost not only a generous benefactor but a friend whose counsel was rendered valuable by the breadth of his views no less than by the earnestness of his purpose to enlarge the domain of practical science in its relation to the welfare of man.

MISCELLANEOUS.

The Naples table.—In the spring of 1893 a petition, signed by nearly 200 working biologists, who represented some eighty universities and scientific institutions, was presented to me, asking that a table be maintained by the Smithsonian Institution at the Naples Zoological Station, for the benefit of American investigators.

This step, urged by so large a number of representative scientific men, having been duly considered and favorably decided upon, the following letter was addressed to Dr. C. W. Stiles, of the American Morphological Society, through whom the petition referred to reached me:

SMITHSONIAN INSTITUTION,
Washington, April 7, 1893.

DEAR SIR: I have given careful consideration to the petitions and papers presented by you, and I have decided, in behalf of the Smithsonian Institution, to rent a table at the Naples Zoological Station for three years, and have already taken steps to secure it.

I shall be glad to be able to learn the opinions of the representative biologists of the United States in regard to the best administration of this table, and I shall esteem it a favor if, through your mediation, an advisory committee of four persons may be formed, one to be nominated by the president of the National Academy of Sciences, one by the president of the American Society of Naturalists, one by the president of the Morphological Society, and one by the president of the Association of American Anatomists, with the understanding that I may, if need arise, feel at liberty to ask their counsel in regard to the regulations for the use of the table, or as to the merits of applicants for it.

The table will be known as the Smithsonian table. Publications resulting from its use will bear the name of the Smithsonian Institution, and such of them as are of sufficient importance will probably be printed in the Smithsonian Contributions to Knowledge.

While the exact conditions will be determined later, I may say, subject to better advices, that it seems to me now that applications for the use of the table should be made to the Secretary of the Institution, who will probably desire to feel authorized to consult the above-mentioned committee concerning them whenever in his judgment occasion arises for doing so.

If this meets your approval will you kindly communicate to the president of each of the societies named my request that he nominate a member of the advisory committee in question.

Very respectfully, yours,

S. P. LANGLEY,
Secretary.

Dr. C. W. STILES.

Four members of an advisory committee were nominated in accordance with my request, as follows:

Maj. John S. Billings, U. S. A., nominated by Prof. O. C. Marsh, president of the National Academy of Sciences.

E. B. Wilson, PH. D., professor of zoology, Columbia University, nominated by Prof. Chittenden, president of the Society of American Naturalists.

C. W. Stiles, PH. D., zoologist, Bureau of Animal Industry, U. S. Department of Agriculture, nominated by Prof. C. O. Whitman, president of the American Morphological Society.

John A. Ryder, PH. D., professor of embryology, University of Pennsylvania, nominated by Prof. Allen, president of the Association of American Anatomists.

These nominations having been approved, I designated Dr. J. S. Billings, U. S. A., chairman and Dr. C. W. Stiles secretary of the committee.

Satisfactory conditions as to the occupancy of the table were arranged with Dr. Dohrn, the director of the station at Naples, and the following contract was duly signed and completed:

[Translation.]

CONTRACT.

1. The director, Dr. A. Dohrn, places a study table in the laboratories of the Zoological Station at Naples at the disposition of the Smithsonian Institution under the following conditions and on the terms stated in article 11 of this contract:

2. The table will be prepared for the occupancy of the student designated by the Smithsonian Institution within one week from the time the administration shall have been advised of his arrival.

3. The table must be supplied with the objects enumerated below, as follows:

- (a) The principal chemical reagents;
- (b) Instruments ordinarily needed in anatomy and microscopy;
- (c) Implements for drawing.

The laboratories will be found provided with the more complicated instruments and apparatus which are commonly used; these, however, will be provided only in duplicate or in triplicate, while they are to serve for the general use. The station does not provide optical instruments for the tables, it being understood that those who come there to work are to furnish their own.

4. The table is supplied with a sufficient number of small aquaria with flowing water, to serve for any experiments which the student may need to make.

5. The animals which are the object of the research, will be renewed as often as possible, and according to the student's needs. It will also be practicable to have material prepared and preserved in known ways, in order that the studies commenced at Naples may be continued elsewhere.

6. The great aquarium attached to the Zoological Station will be open *gratis* to the occupant of the table, either for his entertainment or for his studies upon animal habits.

7. The library of the Zoological Station is in a hall adjacent to the laboratories, and is accessible to the occupant of the table, who may use it as a reading or a writing room.

8. The laboratories will be open at 7 o'clock in the morning in summer and 8 o'clock in winter. In exceptional cases, other arrangements may be made with the administration, though the employ  s are not obliged to open the laboratories before the given hour. From June 20 to August 20 the laboratories will be closed.

9. The occupant of the table will have the right to share in the fishing expeditions sent out from the station, as well as to learn the different methods in use.

10. Injuries to the instruments and utensils caused by the occupant of the table, will be at the cost of the administration, so long as the amount does not exceed 20 francs.

11. The present contract is for the term of three years, and the Smithsonian Institution promises to pay Dr. Anton Dohrn, the Director of the Zoological Station, yearly in advance, the sum of 2,500 francs, in gold, for the rent of the table in the laboratories of the Zoological Station.

Signed in duplicate,
Washington, June 9, 1893.

S. P. LANGLEY,
Secretary of the Smithsonian Institution.

Naples, May 16, 1893.

Professor DR. ANTON DOHRN,
Director of the Zoological Station of Naples.

Numerous applications for the occupancy of the table have been received, but at the close of the fiscal year sufficient consideration had not been given them to render it possible to make any definite assignment.

With a desire for the information necessary to a right administration of the affairs of the table, I have requested that all applications shall be accompanied by credentials showing the qualifications of the candidate to carry on original investigations in some field for which especial facilities are offered at the Naples Station. These credentials are to be accompanied by a scientific history of the candidate, together with a list of such original papers as he may have published.

Those appointed to the table will be expected to make a report at the end of their term of occupation, or, in case of a long residence at the station, to submit such a report to the Institution every three months.

Seal of the Institution.—It having been found advisable that the Institution should have a new seal, a device was prepared by Mr. St. Gaudens, the eminent sculptor, whose æsthetic value, as compared with the one it replaced, is incontestable. One of the first uses of this seal was to affix it to the circular concerning the Hodgkins gift, which has just been referred to. Its use as the seal of the Institution was formally recognized by the resolution of the Regents of January 25, 1893.

Lunar photography.—I have been interested for a considerable time in the possibility of preparing a chart of the moon by photography, which would enable geologists and selenographers to study its surface in their cabinets with all the details before them which astronomers have at command in the use of the most powerful telescopes.

Such a plan would have seemed chimerical a few years ago, and it is still surrounded with difficulties, but it is probable that within a comparatively few years it may be successfully carried out. No definite scale has been adopted, but it is desirable that the disk thus presented

should approximate in size one two-millionth of the lunar diameter; but while photographs have been made on this scale, I do not think that any of them show detail which may not be given on a smaller one.

I have been favored with the cooperation and interest in this work of the directors of the Harvard College Observatory, of the Lick Observatory, and others, who in response to a letter addressed to them on February 10, 1893, have obliged me with many valuable suggestions. This important work is still under advisement.

Delegates to universities and learned societies.—The Smithsonian Institution is not infrequently invited to send representatives to special celebrations instituted by learned societies or universities with which it is in correspondence both in this country and abroad. Whenever practical, special delegates have been designated by the secretary to represent the Institution on such occasions.

Dr. James C. Welling, president of the Columbian University and Regent of the Smithsonian Institution, who was proceeding abroad as a Commissioner of the United States to the Exposition at Madrid in 1892, was appointed delegate of the Smithsonian Institution to the Tercentenary celebration of the founding of Trinity College of the University of Dublin, which took place on July 5-8, 1892.

Dr. George Vasey, botanist of the U. S. Department of Agriculture and honorary curator of the department of botany in the U. S. National Museum, represented the Smithsonian Institution and the National Museum at the Botanical Congress, Geneva, on the occasion of the Columbian festivities, from the 4th to the 12th of September, 1892.

At the celebration of the one hundred and fiftieth anniversary of the founding of the American Philosophical Society of Philadelphia, from May 22 to May 26, 1893, the Smithsonian Institution was represented by Prof. William C. Winlock, Assistant in charge of office; Dr. Goode, the Assistant Secretary, having been unable to attend.

Assignment of Rooms.—A room is still reserved in the basement for the use of the officers of the U. S. Coast and Geodetic Survey for pendulum experiments.

The American Historical Association.—The annual report of the American Historical Association was on February 27, 1893, communicated to Congress in accordance with the act approved January 4, 1889, and the usual public document number of 1,900 copies was ordered printed.

Stereotype plates and cuts.—The collection of stereotype plates of the Smithsonian and Museum, and of engravers' wood cuts and process plates is now so large that its proper cataloguing and storage has called for serious attention. It has always been the policy of the Institution to permit the use of these plates by publishers under reasonable conditions, and the requests for electrotype copies of cuts have grown more numerous. The original cuts are placed in the hands of

an engraver and electrotype copies are furnished at very small cost, the expense being met by the applicant.

Special Smithsonian correspondent in Paris.—M. C. Reinwald & Co., 15 rue des Saints-Pères, Paris, were designated, on June 6, 1893, as special correspondents of the Smithsonian Institution, through whom commissions can be conveniently attended to. I should add that no compensation is attached to this agency.

Russian Physico-Chemical Society.—I deem it not inappropriate to give the following letter received June 29, 1892, from the Russian Physico-Chemical Society:

ST. PETERSBURG, May 31, 1892.

Russian Physico-Chemical Society University to the Smithsonian Institution at Washington:

The universal science reposes on the brotherhood of nations. The United States of America in sending bread to the Russian people in time of scarcity and need gave the most affecting instance of brotherly feeling. The Russian chemists who devote themselves to the service of universal science, at their meeting of the 7-19 of May decided to ask their brethren of the Smithsonian Institute, to transmit the expression of their sincere thanks to all persons or institutions who contributed to the fulfillment of this brotherly aid.

President D. MENDELEEFF.
Secretary D. KONOWALOW.

A copy of this letter was communicated to the chairman of the Russian Famine Relief Committee and to the public press.

Correspondence.—Minor changes have been made in the methods of handling correspondence, with a view to disposing of all letters with the greatest dispatch compatible with the character of the work, and the number of clerks that can be assigned to such duties. During the preceding year a plan was adopted of separating the files in the Secretary's office according to the different branches of the work, independent files being assigned to the Secretary's correspondence concerning the Smithsonian routine proper, the observatory, the museum, the park, etc.; and with each file, separate press-copy books. The files have been designated as follows:

1. Smithsonian proper.
2. The National Museum.
4. The Bureau of Ethnology.
5. The Zoological Park.
6. The Astro-physical Observatory.
11. Assistant in charge.
20. Aerodynamics.
25. Hodgkins fund.

A card index was begun on January 1, 1893, for both letters received and letters written, to facilitate reference to the various files, and this index will be extended back to all letters since January 1, 1892, as opportunity offers.

Each letter of importance is registered as I have described in previous reports, and its course is traced until it is finally disposed of. In addition to letters registered, many are forwarded directly to the Museum, the Bureau of Ethnology, the Zoological Park, the Bureau of International Exchanges, etc., for disposition. Many others, concerning publications, are sent directly to the document room there to be filed and accounted for. Referring now only to letters that are registered in the Secretary's office, 3,184 entries were made for the fiscal year 1892-'93.

A further change in treating correspondence has gradually been forced upon the Secretary, and with the object of obviating the necessity of giving so much of his time to matters of purely clerical routine, a decision was finally reached, to delegate authority to the Assistant in charge of office, to the acting Curator in charge of the Museum, and to the Librarian, to sign routine letters bearing exclusively upon designated classes of correspondence. This has relieved the Secretary of personally attending to correspondence of this class, without essentially impairing his proper supervision of official business.

THE NATIONAL MUSEUM.

The Museum of the Smithsonian Institution, the nucleus of which was Smithson's cabinet of minerals, was formed in part, and for a time entirely maintained, at the expense of the Smithson fund. Subsequently, at the bidding of Congress, the Institution assumed charge of the so-called "National Cabinet of Curiosities," which included the the collections of the United States exploring expeditions; the collections of the National Institute founded in 1840, and numerous other objects and collections which had accumulated under the charge of the Commissioner of Patents. For thirty-five years these two series of collections have been housed and cared for conjointly, and form the nucleus of what is now known as the National Museum.

Each year since 1858 Congress has appropriated a certain sum of money for the maintenance of the National Museum, but up to this time it has not made any special provision for the improvement of the collections by purchase, while it is becoming evident that those received by gift or from other Government sources, though of considerable extent, are of rapidly diminishing consequence, since these things are attaining each year a higher and higher market value, and are tending to be commanded only by purchase.

In respect of this provision for purchase, the National Museum stands at the foot of all American museums, being surpassed even by every municipal museum of note with which I am acquainted.* The disad-

* The American Museum of Natural History, for example, expended \$23,552.89 for additions to its natural history collections during 1892, while the National Museum, which is of very much wider scope, expended only \$5,769.75 during the fiscal year 1892-'93, for collections of all kinds.

vantage in which it stands, when compared with what are now its competitors in the national collections of the leading countries of Europe, has grown painfully obvious. Important collections made in this country of the objects illustrating the vanishing life of its own native races of men and animals—collections which can never be made again, and never be replaced—are being permanently withdrawn to enrich the museums of Europe. This has already gone so far that it is necessary in order to study the past life of our own Mississippi Valley to go to England, while for that of southern Alaska we must go to Berlin, and for the Californian coast we must go to Paris, and so on. It is already then, in European capitals more than in our own, that we have to go for some of the most important studies of our native races; and at the present rate, within a few more years, when the American collector has nothing more left to gather and to sell abroad, it will be in Europe and not in America that the student of past American history must seek for nearly everything that most fully illustrates the ancient life and peoples of the American continent.

This is an exceedingly regrettable circumstance and one which I sincerely hope the National Legislature will be disposed to modify. I may remark in this connection that the National Museum is in danger of forfeiting its proper status also on account of the competition of private collections. With the increase of wealth in the country the desire for the establishment of museums in various cities has been realized and the amount spent for objects in many of them is far greater than the National Museum has ever had at its disposal. While the National Museum has always desired to cooperate fully with private establishments of like nature, it is felt that the scientific and educational collection of the Government should be in nowise inferior.

During the past year the Museum has been, as hitherto, under the charge of Dr. G. Brown Goode, the Assistant Secretary of the Institution. Mr. Frederick W. True was designated by me curator-in-charge, and has assumed the general management of the Museum at different times during the absence of the Assistant Secretary.

A full report upon the operations of the Museum has been prepared by Dr. Goode, and will form a separate volume, of which an abstract is given here later.

The Museum has been engrossed during the year in completing the preparations for the exhibits at the World's Columbian Exposition, and this work caused the practical suspension of many regular operations. The exhibits were ready at the appointed time and were installed in the Government building in the Exposition by the curators of the Museum, under the direction of the Assistant Secretary, who was the representative of the Institution on the Government board.

A statement regarding the exhibits of the Museum will be found in the report of the Assistant Secretary.

In connection with this work mention should be made of the Colum-

bian Historical Exposition held in Madrid in the fall and winter of 1892. This Exposition was a part of the very extensive celebration of the four hundredth anniversary of the sailing of Columbus, held in the various cities of Spain under the direction of the Spanish Government. A commission was appointed by the President to represent the United States, consisting of Rear Admiral Luce, U. S. N., Dr. J. C. Welling, one of the regents of this Institution,* and Mr. Goode, its Assistant Secretary, and a liberal appropriation made for the expenses of transportation and maintenance of the exhibits. Extensive collections were sent by the Smithsonian Institution, taken from its own collections and borrowed from its collaborators and correspondents. They were ethnological, archeological, and historical, and were supplemented by other collections sent by the University of Pennsylvania, the Bureau of American Republics, and the Hemenway Expedition. The exhibition in Madrid was as a successful one, and the exhibit of the United States was highly appreciated by the Spanish Government, and led to its extraordinarily generous participation in the subsequent celebration in Chicago. Gold medals were awarded to the Smithsonian Institution, to the Museum, and the Bureau of Ethnology.

The Museum building has been visited by a larger number of persons during the past year than ever before, the total number exceeding 300,000. This growing interest in the collections on the part of the public, is a gratifying circumstance, and leads to the belief that the care bestowed upon the exhibition series is not unappreciated.

On account of the crowded condition of the exhibition halls, the effective display of many of the collections of the Museum is prevented. The proper lighting of the cases is interfered with and the arrangement of the specimens is necessarily less systematic than is desirable.

The Museum has continued to distribute to educational establishments throughout the country such collections of duplicate natural-history specimens as it has been found practicable to prepare. Somewhat more than 13,000 specimens have been sent out during the year. These, however, have been far from sufficient to meet the demands of applicants, and numerous requests remain unacted upon. I regard this distribution of specimens as one of the most important operations of the Museum, and one on which much more time and money could be profitably spent. With the resources available it has been impossible to prepare collections in more than a few lines, and these have all been more or less imperfect. The high schools of the country, to which such collections would be of much value, can not at present be supplied.

My attention has been called by the Assistant Secretary to the inadequate size of the editions of the publications of the Museum. It is not at present possible to supply all the larger libraries of the world, and the majority of the smaller ones, in many of which they would be of

* Dr. Welling was recalled by official business after reaching London, and was replaced by Dr. Daniel G. Brinton, of the University of Pennsylvania.

high utility, are entirely unprovided. Individuals do not receive the volumes at all, but only such papers extracted from them as relate to the scientific work in which they are immediately concerned. It is much to be desired that larger editions should be provided for.

During the year two volumes of the Proceedings and one complete number and parts of another number of the Bulletin were published.

The Museum has been benefited, as in previous years, by the co-operation of the several Departments and Bureaus of the Government. Special mention should be made in this connection of the many courtesies received from the consular service of the Department of State. The Quartermaster's Department of the Army has assisted materially by providing transportation for bulky collections coming to the National Museum from remote localities. The Museum has further been able to avail itself of the services of officials of the Navy Department, Department of Agriculture, the U. S. Geological Survey, and U. S. Fish Commission, who have acted in the capacity of honorary curators.

BUREAU OF ETHNOLOGY.

The researches of the Bureau of Ethnology relating to the American Indians were continued during the year in accordance with law, under the direction of Maj. J. W. Powell, who also directed the work of the U. S. Geological Survey.

As during previous years the work of the Bureau has been conducted with special reference to the American Indians in their primitive condition, with a view of securing the largest possible amount of information, both in the form of records for print and in the form of material objects for preservation and future study in the National Museum. Thus extensive collections are made annually, and the value of these collections is greatly enhanced by reason of the full notes always prepared and the extended publications sometimes made by the collectors.

The non-material collections of data relating directly to the native Americans, to the distribution of tribes, to their habits and customs, to their arts, languages, institutions, and beliefs, are also abundant and, it is believed, of permanent value. Detailed information on these subjects is published in three series of reports additional to the abstracts appearing in the Report of the Secretary of the Smithsonian Institution. The thirty volumes already published form a rich storehouse of facts relating to our native races. Four volumes were added to this library during the year.

One of the most interesting questions ever raised concerning the early peoples of this country related to the artificial mounds scattered abundantly over the Mississippi Valley and with less abundance over most of our territory. Many investigators have given attention to these works of a vanished race; and it came to be a general opinion

that the builders of the mounds were a distinct people ante-dating the native races found in possession of the land on the advent of the Europeans. Within the last five years extended surveys of the mound territory have been made by collaborators of the Bureau under immediate instructions from the Director and by Dr. Cyrus Thomas. An elaborate report on this subject has been prepared during the year and is now in press. It is the united opinion of the officers of the Bureau that this document contains the solution to the mystery of the mounds; very greatly to the surprise of the investigators who began the work, they have been led to believe that the mounds and the art products contained therein are in no wise distinct from the works of the modern Indians, and that the distribution of tribes can now be studied from the mounds themselves as well as from other aboriginal records.

The work of the Bureau on Archeology or prehistoric arts has been conducted with energy and exceptional success. Until recently many of the leading students of American antiquities were Europeans; and thus it happened that the classification of American art products was to a large extent an imported one, corresponding to foreign generalizations and ideals rather than to any indigenous standard. Thus a history of succession of peoples, representing increasing grades of culture, has been wrought out. As will be seen from the reports of the Director and collaborators of the Bureau, however, an indigenous classification has been also developed by it, and it has been shown to be probable that the objects supposed to represent the series of culture stages are in most cases at least the handiwork of single tribes during the same epoch. These researches were conducted chiefly by Prof. W. H. Holmes, with the assistance of Messrs. Fowke and Dinwiddie. If these important results obtain general acceptance, the effect will be to shorten the earlier estimates of the antiquity of man on this continent, and in this respect it will be observed that they are coincident with those flowing from the mound researches.

Important investigations concerning the beliefs of the Indians of different parts of the country have been conducted during the year, notably by Mrs. M. C. Stevenson and Mr. F. H. Cushing among the Zuñis, and Dr. Hoffman among the remnants of the Lake Superior tribes. An elaborate memoir by the first-named collaborator was sent to press during the year.

The principal work relating to the sociology or institutions of the aborigines was that of continuing the preparation of a tribal synonymy or dictionary of tribal names, including not only those names applied by white men, but the names current among the Indians themselves. Connected with this work is a detailed study of the literature relating to the Indian languages by Mr. James Constantine Pilling. The results of this study form a bibliography which has already come to be recognized as a standard by the bibliographic students of the world.

An important line of investigation related to the means of interchanging ideas among our native races, including gesture, speech, and picture writing, as well as spoken language. The primitive modes of expression by means of gestures or pantomime and by means of glyphs or pictures are held by students as of special interest, in that they represent the beginnings of language. These modes of conveying ideas have received much attention by collaborators of the Bureau, notably Col. Garrick Mallery. An elaborate memoir on the "Picture writing of the American Indians" is incorporated in the tenth annual report of the Bureau. This memoir is a practically exhaustive monograph on the subject to which it relates; the illustrations, which number nearly fourteen hundred, represent the aboriginal picture writing of all portions of the country with fidelity, while the meanings of the glyphs are interpreted and discussed in detail in the text. A large body of material relating to the sign language of the aborigines has been collected, and during the year progress was made in arranging this material for publication. In no other part of the world have the opportunities for collecting detailed information concerning primitive modes of expression been so favorable as in North America; and it is thought that these reports prepared by collaborators of the Bureau, will serve at once as a record of past and passing races and a basis for philological researches in other countries.

The spoken languages of various tribes of Indians were studied and recorded. One of the most extensive aboriginal linguistic families was the Siouan, including the Indians of the northern plains from the Rocky Mountains to the Mississippi, and from the Saskatchewan nearly to the Red River of the South. One of the publications of the year was a "Dakota-English Dictionary," in which the language of the best-known division of the Siouan family is made accessible to students, this work, begun by the late Dr. Riggs, being completed by Mr. J. Owen Dorsey, a linguist especially familiar with the languages of this stock. The dictionary forms a quarto volume of nearly seven hundred pages. The language of the Biloxi Indians of Louisiana was also investigated during the year by Mr. Dorsey; Dr. Gatschet made a detailed study of the Peoria, Shawnee, Arapaho, and Cheyenne languages in Indian Territory, the work on the Peoria being complete with respect to both vocabulary and grammar.

The Iroquoian languages also were the subject of study by Mr. J. N. B. Hewitt. Unwritten language is one of the most evanescent of human characters; already the languages of many of our native tribes have entirely disappeared, save for a few greatly modified terms preserved as geographic names; and it seems especially important to record the rapidly changing native languages thus far remaining. Some of the vocabularies and grammars collected by the Bureau were derived from half a dozen or fewer individuals who alone represent their tribe; in one case (the Chinookan) the language was preserved through infor-

mation obtained from the last representative of his people. A large part of the publications of the Bureau relate to aboriginal languages; yet the more or less fragmentary material, incomplete but constantly growing, relating to this subject is still more voluminous; and students of linguistics throughout the world are to be congratulated on the existence of this rich storehouse of material collected through the labors of the Smithsonian Institution and of the Bureau of Ethnology.

In addition to the researches in field and office several collaborators of the Bureau were employed during the closing months of the year in preparing an ethnologic exhibit for the World's Columbian Exposition at Chicago. This exhibit was completed and installed duly; and it is a source of gratification to be able to say that it proves constantly attractive to visitors, and it is believed to have been also highly instructive.

The details of the work of the Bureau are set forth in the report of the Director, Maj. J. W. Powell, which forms the accompanying Appendix II.

SMITHSONIAN INTERNATIONAL EXCHANGE SERVICE.

The International Exchange Service has always been intimately connected with the parent institution, which has until lately aided it largely from its private funds, and which still aids it by giving it rooms rent free and in other ways.

It may be said to be at present upon as satisfactory a basis as it seems possible to place it with the appropriations that are now made by Congress.

As an illustration of the extent of this special part of the Institution's activities, it may be stated that it has now about 24,000 active correspondents, of whom 14,000 are in Europe, 200 in Africa, 500 in Australia, and about 9,000 in the various countries of the Western Hemisphere. In the course of this work the Institution has gathered at Washington an immense collection of books, found nowhere else to so great an extent, bearing chiefly upon discovery and invention, which, with others, now occupy nearly 300,000 titles. These are deposited temporarily with the National Library at the Capitol.

The details of the operations of the service are to be found in the curator's report appended. Improvements in the service are needed in an increase in the clerical force for office work, or rather a return to the number employed in 1891-'92. There is need also for securing a more prompt dispatch and distribution of packages abroad, which can only be brought about by an increase of appropriation.

The United States Government is under treaty obligation to maintain an exchange service with ten foreign countries, and with France, England, and Germany a special exchange arrangement is in existence. In the two latter countries, where there are paid agents of the Institution, and in other countries where official exchange bureaus have been established the transmission of publications, while somewhat slow, is generally efficient. In other cases, however, the present arrangement is by

no means satisfactory, and it seems desirable, either through diplomatic channels or through a special representative of the Institution sent abroad, to secure the interest and cooperation of the foreign governments and the learned societies where no official exchange bureau has been established.

The greater part of the expense of the service is now met by direct appropriation for the purpose by Congress to the Smithsonian Institution. A part of the expense is also met by appropriations to different Government bureaus from their contingent funds, the Regents of the Institution having decided to make a charge to all Government bureaus of 5 cents per pound weight for the transmission of their publications or for the publications received for them from abroad.

Special acknowledgments are due to the Treasury Department for designating one of its officers at the New York custom-house to receive and transmit to Washington the international exchange cases addressed to the Institution, and I may in this connection again quote the remark made by Prof. Henry in his report for 1854:

There is, therefore, no port to which the Smithsonian packages are shipped where duties are charged on them, a certified invoice of contents by the Secretary being sufficient to pass them through the custom-house free of duty. On the other hand, all packages addressed to the Institution arriving at the ports of the United States are admitted without detention, duty free.

By referring to the report of the curator, in the appendix, it will be seen that over 100 tons of books passed through the exchange office during the fiscal year 1892-'93, and while the service is used almost exclusively for the transmission of printed matter of a scientific nature, natural history specimens, having no commercial value, are occasionally transmitted under special permission, when they can not be conveniently forwarded by the ordinary means of conveyance.

The expenditures for the year have been \$18,518.25, of which \$17,000 were appropriated by Congress, \$1,396.64 were paid by Government bureaus, \$87.35 by State institutions and others, leaving a deficiency of \$34.26.

The amount estimated for the exchange bureau for the year 1893-'94 was \$23,000, a sum which it was hoped would render it unnecessary to call upon the different Government Departments for a part of the expense attending the transmission of their publications, and would also render it possible to put into effect a second treaty entered into by the United States and other countries at the same time as the treaty referred to above, by which each country undertook to distribute its parliamentary proceedings immediately when issued. On account of a lack of appropriations for this purpose no action has yet been taken by the United States for carrying out this latter agreement.

In my report for 1890 I stated that there had been expended from the Smithsonian fund for the support of the international exchange system, in the interests and by the authority of the National Government,

\$38,141.01 in excess of appropriations, advanced from January 1, 1868, to June 30, 1886, for the exchange of official Government documents, and \$7,034.81 in excess of appropriations from July 1, 1886, to June 30, 1889, advanced for the purpose of carrying out a convention entered into by the United States, or an aggregate of \$45,175.82, which has been paid from the private fund of James Smithson, for purely governmental expenses. This has still to be reimbursed to the Institution.

A memorandum in regard to the matter was duly transmitted to a member of the Board of Regents, in the House of Representatives, for the purpose of taking the necessary steps to procure a return by Congress to the Smithsonian fund of this last-mentioned sum, namely, \$45,175.82, but I am not aware that action has been taken upon it.

NATIONAL ZOOLOGICAL PARK.

It should always be remembered that the establishment* of the National Zoological Park resulted largely from a desire to keep from extinction species of American animals, several of which are now upon the point of vanishing from the face of the earth, and will vanish forever if something is not done at once to preserve them.

The paramount need of preserving these races by immediate legislative action, if they are to be preserved at all, the great and constantly increasing difficulty of obtaining specimens of some of them, the little that is known of their habits, and the impossibility of ever learning more, unless some immediate measures are taken to make careful observation possible, render it exceedingly desirable that such measures should be taken officially, and no more economical or effective plan could be devised than that of providing a moderate extent of land, near the seat of Government, duly protected and guarded, where such animals as could be secured might be kept in a state as near as possible to that to which they had been accustomed, and under conditions where they might be expected to breed, and continue their species, as they are known not to do in ordinary menageries.

It was not indeed thought that any efficient check could be given to the final extinction of these animals solely by such a limited number as could be thus preserved, but it was considered that their presence here at the Capital would be not only useful as regarded the number saved, but as a constant object lesson, under the eyes of the legislature, and in this way, a most important adjunct to the larger reservations like the Yellowstone Park; while it was evident that opportunity could thus be afforded to study and observe their habits and characteristics, where they were under the eyes of the numerous naturalists in the Government service, in a more satisfactory manner than would be possible in a remote wilderness.

The act providing for the purchase and creation of the National Zoological Park introduced also a subordinate feature, that of the

* Reference may be made to the following pages in the Annual Reports of the Smithsonian Institution: Report for 1888, p. 42; for 1889, p. 27; for 1890, p. 34, and Secretary's Report for 1891, p. 21, and 1892, p. 28.

recreation of the people, but by placing one-half of the expense of purchase and maintenance upon the taxpayers of the District, Congress in fact, though presumably not in intent, made this subordinate feature predominant in a plan whose inception arose in a simpler and more utilitarian idea.

This predominance arose from the natural wish of the local taxpayer to receive entertainment for his money and not to spend it for objects of remote and national importance. This demand must be admitted to have been but reasonable, from the point of view of residents of the District, and it made itself felt through Congress in many ways, if not through the terms of formal legislation.

Those to whom was delegated the power of carrying out the mandates of Congress were thus confronted by a different task from that originally contemplated by one in some way not consonant with it, and by a far more expensive one. In place, for instance, of the large inexpensive paddocks for inclosing and secluding the animals under the conditions of wild life and secluding them with the aim of enabling them to increase in the undisturbed retirement necessary, must be substituted comparatively expensive buildings, with the opposite aim of exhibiting the animals obtained. A system of roadways that should afford the public access to all parts of the park where animals are kept had to be devised and in ways too numerous for detail the necessity was imposed of forming the National Zoological Park more on the model of an ordinary zoological garden than of the first large and simple idea.

It was impossible to do this within the sums calculated to carry out the original plans, but no more has been granted. What has been done has been done, then, incompletely, though with an extremely economical expenditure, and it is perhaps a matter of congratulation that it has been possible to do so much with so limited an amount.

The appropriation made for the National Zoological Park by the sundry civil bill passed August 5, 1892, was in the following terms:

For continuing the construction of roads, walks, bridges, water supply, sewerage and drainage, and for grading, planting, and otherwise improving the grounds, erecting and repairing buildings and inclosures for the animals, and for administrative purposes, care, subsistence, and transportation of animals, including salaries and compensation of all necessary employés, and general incidental expenses not otherwise provided for, fifty thousand dollars, one-half of which sum shall be paid from the revenues of the District of Columbia and the other half from the Treasury of the United States; and a report in detail of the expenses of the National Zoological Park shall be made to Congress at the beginning of each regular session.

The previous year had fully demonstrated that the park successfully fulfilled one of the purposes for which it was created—that of the “instruction and recreation of the people.” After having done all that lay in my power for the promotion of the primary objects of the park*

* A full statement of the number and condition of these animals will be found in the report of the acting manager. It may be stated here, however, that indigenous wild animals constitute at present a large majority of the whole.

it became necessary to further, as far as possible, and in the same connection, the recreation of the public. To this end, and to that of convenience and safety, the roadways have been widened and extended, footways have been placed on the bridge, the access to the principal animal house and to the principal outdoor cages has been improved, and all inclosures considered unsafe have been properly strengthened or defended.

Since the Rock Creek electric railway has been in operation many passengers by that route enter the park by the western entrance upon Connecticut avenue extended. More than 2,000 persons have sometimes entered here during a single day. This has made it necessary to extend the main road through the park to that entrance, which has been done on the lines indicated by Mr. F. L. Olmsted, and gives a driveway through the most beautiful part of the park. The funds at the disposal of the park were insufficient to complete this road in a permanent manner. As soon as practicable it should be macadamized and made equal to the suburban roads with which it communicates.

It is necessary to emphasize the fact that the number of visitors to the park so far exceeds all the earlier calculations that unexpected outlays have become necessary. A wider sidewalk of a permanent character is needed from the Quarry road entrance to that at Connecticut avenue. A temporary wooden walk has been placed to the animal house from the first-named point, but is far too narrow for the crowds entering there every Sunday and holiday, while no sidewalk exists from the western entrance of the park.

The bridge near the Quarry road entrance has proved quite insufficient for the crowds of carriages and foot passengers that throng it upon every holiday. It was and still is greatly to be regretted that under the actual appropriations a larger and more tasteful structure could not have been built at this point; it was erected under the necessity of getting visitors across the river in some way, and is in a form entirely unsatisfactory to those who, under such necessity, designed it. Some relief has been given during the year by the addition of narrow footways on either side of the driveway. These are quite too narrow, but are all that the present structure will allow compatible with safety. It may be found necessary to build a footbridge at a point higher up the stream to somewhat relieve the pressure at this point.

The addition to the principal animal house mentioned in last year's report has been completed and fully occupied. It is merely a frame shed built in as cheap a manner as is consistent with safety and warmth, and it appears incongruous when compared with the solid stone structure of which it forms an annex. The original design of constructing this entire building of stone should not be abandoned. It is already found to be insufficient for the needs of the park, and must at no distant day be further extended. It will be necessary hereafter to bear in mind that the cages for animals must be larger and confined

usually to but one side of the building. The throngs of visitors are now sometimes so great that it is impossible for them to view the animals properly when the cages are small and scattered along both sides of a passageway.

The lack of any provision for the purchase of animals has worked serious disadvantage to the collection. Under the most favorable circumstances the mortality in a collection of animals confined under unnatural conditions is very great, and constant additions must be made if its scientific value is to be maintained. The park has for the last year been forced to depend upon gifts, loans, and collections sent from the Yellowstone Park. Gifts have been rare and mostly insignificant. The animals collected at the Yellowstone Park by direction of the honorable the Secretary of the Interior have, while important and valuable, cost more for transportation alone than similar animals would have cost if purchased of dealers and safely delivered at their expense. Various other schemes of collection have been tried, all of which have proved more expensive than purchase would have been. It is hoped that in time, as the National Zoological Park becomes more widely known, the same advantages of cheap purchase will be offered to it as are now made use of by dealers; that is, that the animals brought in by sailors or captured by hunters will be sent to it at low prices. Even now such offers are frequently made, though they are necessarily refused, as the appropriation does not allow any purchases.

Experience has shown that there should be provision made for a resident superintendent. At present the entire park and animals are left at night in charge of watchmen only. If any exigency arises it must wait for morning to bring relief. The isolation of the buildings housing the animals, and the distance of the park from town, make it the more necessary that there should always be at hand, within call, some person of authority to direct in case direction is needed. For this the Holt house may be made available. It is in a part of the park reserved for administrative purposes, and a portion of it now accommodates the office. With a small outlay it could be made a suitable dwelling. The advantages of such an arrangement are too obvious to be recounted, and the effect upon the employes of the constant presence of the superintendent would be very beneficial.

The number of animals at present in the park is 504. Of these 322 are native and 182 foreign. In the appendix to this report tables are given showing the accessions in detail.

ASTRO-PHYSICAL OBSERVATORY.

In my report for 1890-'91 reference was made to the circumstances which led to the establishment of the astro-physical observatory, and in that of last year I gave a brief description of the general object and

scope of such an establishment, touching upon some of the essential features of the work which had been undertaken under my direction.

An explicit description of the specially important investigation which has been continued during the last year, and which is now drawing to a completion, can not so well be given here as in a later portion of the report to which the reader is referred, but the general object of the immediate work is, as has already been stated, the detailed investigation of that great spectral region, still nearly unknown, where yet the greater portion of the solar energy is known to be displayed; or, in other words, of that invisible portion of the solar spectrum which lies beyond the limit of the red.

That the solar spectrum did not cease at the limit of visibility has long been known, and the attention of many distinguished physicists has been directed to the investigation of this invisible part, whose presence is manifest neither to the eye nor to any ordinary process of photography, but which nevertheless comprises more than three-fourths of the energy which the sun sends to us. Were the range of the human eye vastly extended so as to enable us to receive impressions corresponding in character to the kind of energy which is present in this infra-red region we should see in it phenomena of precisely the same character as we now see in the limited spectral region to which we are physiologically limited. It was probably this idea which led Melloni to the use of the term "heat color" to convey to the mind some idea of this similarity between the invisible and the ordinary visible spectrum, and this term expresses by the force of association the characteristics distinguishing one portion of this region from another, characteristics which, although unrecognized by the eye or by any of our senses directly, are yet more striking in their various physical results than the various colors which mark out to the eye the great divisions of the visible spectrum.

This invisible, then, is marked by narrow bands or lines, which are almost entirely devoid of energy, quite like those which appear in the visible spectrum as black lines and are known as the "Frauenhofer lines." It is to the study of these Frauenhofer lines of the visible spectrum, that we owe nearly all those recent advances which have not only given us definite information as regards the constitution and nature of the heavenly bodies, but have been of immense advantage in the study of meteorological and atmospheric phenomena on the earth. The practical importance of the study of the character of these lines in the invisible spectrum (where their intensity and probably their number is far greater than in the visible) then is evident.

Here, however, all ordinary methods of spectroscopic investigation fail; but long since the writer devised a method which has in the course of the last two years been perfected to such a degree as to enable us to search out the lines in this invisible spectrum and to map them with

a degree of accuracy only inferior to that which can be attained by the eye.

The instrument by which this is accomplished is the bolometer, which, as now constructed, is a minute strip of metal barely $\frac{1}{500}$ of an inch wide, and less than $\frac{1}{5000}$ of an inch thick. Through this frail thread of metal a current of electricity is continually kept flowing. When the spectrum, visible or invisible, is thrown upon it the thread is warmed and the current decreased by an amount corresponding to the intensity of the effect received, while novel instruments specially mounted and constructed are in electric connection with the thread and now automatically record every minute change in this current.

With late improvements these instruments are so delicate that a change of temperature of one millionth of a degree is readily detected and even measured, and it is easy to see that as a consequence of this delicacy the greatest care must be taken in their use. Thus the laboratory must be almost completely darkened, and closed tightly, so as to exclude all drafts and to keep it at as nearly a uniform temperature as possible, while for other reasons it must be kept under constant hygrometric conditions.

The passage of wagons or carriages in the neighboring streets even is liable to cause serious trouble. Hence, the necessity for as complete isolation of the laboratory as possible, and the rigorous exclusion at all times of all whose presence is not indispensable.

In addition to these difficulties there are others of specially trying character due to the nature of the work.

To maintain other necessary conditions, the opening of a door or window for purposes of ventilation is forbidden, even in summer, although the temperature sometimes rises to 100° and even 110° , rendering the work of observing in the small, non-ventilated and darkened room very trying to the health of the observer. Frequent changes in the staff of the Observatory have been necessary for this and other reasons, and the progress of the work has been delayed in consequence. In spite of these and other difficulties, most of which are due to the very temporary and inefficient nature of the small wooden building in which the work is carried on, and its proximity to the traffic-laden streets, the expectations of last year have been largely realized, and a detailed publication of the work accompanied by charts showing several hundred new and before unknown lines, will shortly be issued.

Important as these results are, they are but the beginning of what it may be hoped will be accomplished, with proper facilities.

In view of what has been already accomplished, I hope that Congress will see fit to make provision for the needs of the Astro-physical Observatory in the provision of a suitable site, the money for a small permanent building being already available through the provisions made by friends of the Institution whose contributions for this purpose have already been acknowledged.

NECROLOGY.

RANDALL LEE GIBSON.

Randall Lee Gibson was born at Spring Hill near Versailles, Ky., September 10, 1832; was educated in Lexington, Ky.; in Terre Bonne Parish, La.; at Yale College, and in the law department of the Tulane University of Louisiana. During the civil war he commanded a company, regiment, brigade, and division in the Confederate army. He was a representative in the Forty-fourth, Forty-fifth, Forty-sixth, and Forty-seventh Congress, and was elected to the Senate in 1883, and his second term as Senator would have expired on March 3, 1895.

Senator Gibson was originally appointed a Regent of the Smithsonian Institution, and was reappointed March 28, 1889, filling the office till his death, on December 15, 1892. His services as a Regent were warmly recognized in the memorial and resolutions presented at the meeting of the Board on January 25, 1893.

Senator Gibson brought to the performance of his duties as Regent a rare preparation as student, scholar, and statesman. With inherited talents for oratory, and with strong literary tendencies, he was surrounded in youth by all the influences that direct the energies of a man to the public welfare. At Yale College he took a very prominent stand in a group noted for talent and enthusiasm. Foreign travel, the study of law, the life of a planter, a distinguished military career, and long service in the Congress of the United States, filled his capacious mind with a store of a rich and varied experience, and trained him for the highest duties. Life was to him a consecration to public duty, and the performance of that duty his highest felicity. Benevolent, brave, patient, prudent, faithful, his grace and gentleness were the rich drapery of an inflexible will and tenacious purpose.

He came to the Smithsonian Institution as a servant animated by the fullest sense of his responsibilities and self-pledged to a rigid performance of them. His interest in the Institution has been limited only by the conditions of his position. His death, which occurred at Hot Springs, Ark., on December 15, 1892, is a loss to his State and his country, in whose councils he has served for eighteen years.

THOMAS GEORGE HODGKINS.

Thomas George Hodgkins was born in England in 1803, and his early boyhood was spent there. When about 17 years of age, led by a youth's love of adventure, as well as by the desire to aid his family, then in somewhat reduced circumstances, he shipped on one of the East India Company's vessels, and made a voyage to the farther east, where he narrowly escaped death by shipwreck. Consequent upon this misadventure, came confinement in a hospital in Calcutta for some months. During this period of enforced quiet and physical inaction, he formed the resolve that his life, if spared, should henceforth be devoted to advancing the welfare of his fellow men.

After recovery he returned to England, where he married. A few years later he came to the United States, and in 1830 established himself as a manufacturer in New York City. Such success attended his business ventures that in 1859 he withdrew from active pursuits and returned to Europe, where he traveled for some years. His heart, however, led him again to this country, which he had chosen as the home of his early manhood, and which he now made the abiding place of his mature years. In 1873 he bought a country place near the village of Setauket, on Long Island, which he named "Brambletye Farm," and which became his home for the remainder of his life.

Those who had the privilege of a personal acquaintance with Mr. Hodgkins saw in him not only a man of unusual judgment in business affairs, of broad and far-reaching philanthropy, and of deep sincerity in his purpose to benefit his fellow-creatures, but they were struck by the breadth of his views as expressed in connection with subjects generally held to pertain more exclusively to purely scientific research, every domain of which he gladly sought to make contributory to his earnest desire to benefit mankind.

His life was simple and his wants but few, and requiring only a small portion of the products of the home farm for his own use, he pursued his long-established habit of systematic benevolence by giving the remainder to those around him.

Fulfilling also the purpose, formed long years before, to further the good of mankind by all means at his command, he devoted the greater part of his large fortune to various benevolent objects, reserving but a comparatively small sum for his own support.

His sympathy for the helpless and weak led him to contribute largely to the American Society for the Prevention of Cruelty to Children, and to the American Society for the Prevention of Cruelty to Animals. He gave \$100,000 to the Royal Institution of Great Britain and \$200,000 to the Smithsonian Institution, stipulating that while the latter sum should be included with the original Smithsonian Foundation, that the income from one-half of it should be devoted to researches and investigations on atmospheric air in connection with the welfare of man.

The death of Mr. Hodgkins occurred at his home in Setauket on the 25th of November, 1892. Those whose duty it is to carry out the plans and to administer the trust laid upon them by the bequest of this man, who so simply and earnestly determined to make the world better by his life, are glad to know that he had the satisfaction of living to see, and to approve the initiatory steps taken in administering the Hodgkins fund of the Smithsonian Institution. A biography of him, in some respects fuller and more personal, will be found in the minutes of the Board of Regents for the present year.

Respectfully submitted,

S. P. LANGLEY,
Secretary of the Smithsonian Institution.

APPENDIX TO SECRETARY'S REPORT.

APPENDIX I.

THE NATIONAL MUSEUM.

The detailed report of the Assistant Secretary in charge, upon the operations of the Museum for the year will be published as Part II of the Report of the Smithsonian Institution. I shall here speak of only the more important matters.

Additions to the collections.—The additions to all departments of the Museum during the year number 82,148 specimens. These were for the most part miscellaneous in character, and, while valuable in themselves, did not tend to so large an extent to supply gaps in the various series as would be the case were larger funds available for purchases. Important collections made by the U. S. Geological Survey, U. S. Fish Commission, and several other bureaus of the Government, in connection with their regular work, have been transmitted to the Museum. With the care of such collections the Museum is charged by act of Congress.

A table showing the number of specimens now in each department of the Museum and for each year since 1882 accompanies the report of the Assistant Secretary which has been already referred to.

The scientific staff.—The number of scientific departments in the Museum remains the same as last year, and few changes in the personnel have been made. Mr. Frederick W. True, curator of mammals, has been designated "Curator-in-charge" and acts as the executive officer of the Museum, in the absence of the Assistant Secretary.

The proportion of honorary curators remains the same as last year. About five-sevenths of the departments are presided over by unpaid officers who are officially attached to other departments and bureaus of the Government, especially the U. S. Geological Survey and the U. S. Fish Commission. This arrangement is in the interest of economy, but it is not conducive to the general welfare of the Museum that the proportion should be so large as at present, since the necessity of devoting most of their time to other matters makes it impossible for the honorary curators to advance the work of their departments as they could if they were attached to the Museum alone.

Distribution of specimens.—It has for many years been customary to distribute to educational establishments, as far as practicable, the duplicate material separated from the Museum collections. This has been possible hitherto, as a part of the systematic operations of the Museum, only in the case of fishes, marine invertebrates, rocks, minerals, and casts of prehistoric implements, although special collections have occasionally been prepared to meet special needs. A large number of sets of rocks and minerals have been sent out during the year. During the two decades from 1871 to 1890 about 278,000 specimens in all were distributed. The duplicates in other departments of the Museum are being arranged in sets for distribution as fast as the facilities at the disposal of the curators permit.

During the year ending June 30, 1893, the number of specimens sent out in exchange or distributed to educational institutions was 13,581.

Visitors.—The total number of visitors to the Smithsonian building during the year was 174,188, and to the Museum building 319,930, giving a total of 494,188 persons who

visited the two buildings. This total shows an increase of 109,476 over the previous year.

Publications.—The Report of the National Museum for 1890 (Part II of the Smithsonian Report) has been published, and that for 1891 will shortly be issued. The report for 1892 is in the hands of the Public Printer.

Volume XIV of the Proceedings of the Museum has been issued in bound form, and all the separate papers composing Volume XV have been received and distributed. The manuscript of a number of papers belonging to Volume XVI has also been sent to the Public Printer, and several of these were issued in pamphlet form before the close of the fiscal year.

Part F, of Bulletin No. 39, "Directions for collecting and preserving insects," by C. V. Riley, and Part G, of the same Bulletin, "Instructions for collecting mollusks and other useful hints for the conchologist," by William H. Dall, and also Bulletin 40, "The Published Writings of George Newbold Lawrence, 1844-1891," by L. S. Foster, have been published. Bulletin 41, "The Published Writings of Dr. Charles Girard," by G. Brown Goode, and Bulletin 42, "A preliminary descriptive catalogue of the systematic collections in economic geology and metallurgy in the U. S. National Museum," by Frederic P. Dewey, were issued during the preceding year.

The manuscript for Bulletin 43, "A Monograph of the Bats of North America," by Harrison Allen, M. D., Bulletin 44, "Catalogue of the Lepidopterous Superfamily Noctuidæ found in Boreal America," by John B. Smith, Bulletin 45, "The Myriapoda of North America," by Charles Harvey Bollman, and Bulletin 46, "Monograph of the North American Proctotrypidæ," by William H. Ashmead, has been sent to the Public Printer, the illustrations have been engraved, and the text put in type. Special Bulletin No. 1, "Life Histories of North American Birds," by Capt. Charles E. Bendire, honorary curator of birds' eggs in the Museum, has been issued. This is the first quarto volume published by the Museum. Special Bulletin No. 2, "Oceanic Ichthyology," a monograph of the deep sea and pelagic fishes of the world, by G. Brown Goode and Tarleton H. Bean, is in the hands of the Public Printer, and it is expected that the volume will be ready for distribution early in the next year.

The demand for the Museum publications has increased to such an extent that many worthy applications are daily refused. An increase in the allotment for printing can not be too strongly urged, in order that the Museum may be enabled to place a full series of its publications in representative libraries in different parts of each State. If a wider distribution of publications of the Museum were provided for, the Museum would undoubtedly receive in exchange the valuable publications of many scientific institutions which are at present only meagerly represented in its library.

The World's Columbian Exposition.—On April 25, 1890, an act "to provide for celebrating the four hundredth anniversary of the discovery of America by Christopher Columbus by holding an international exhibition of arts, industries, manufactures, and the product of the soil, mine, and sea in the city of Chicago, in the State of Illinois," was approved by the President of the United States. This act authorized the participation of the Executive Departments, the Smithsonian Institution and National Museum, and the U. S. Fish Commission in the Exposition. A Government Board of Control was organized, consisting of representatives of each of these Departments. They were appointed by the President of the United States, and under their control was placed the preparation, installation, and administration of the Government exhibit. Upon my recommendation, Dr. G. Brown Goode, Assistant Secretary of the Smithsonian Institution in charge of the National Museum, was appointed Representative of the Smithsonian Institution and National Museum.

As soon as the character and scope of the exhibit had been decided upon, agents were at once instructed to proceed to various localities, with a view to collecting material necessary for illustrating the condition of the continent at the time of its

discovery by Columbus, and for representing the animal life and the natural resources of the country. The work of mounting and arranging the specimens was immediately begun, and continued until the beginning of the present calendar year.

In February, the first shipments to Chicago were made. The entire exhibit filled twenty-nine cars. On the opening day, May 1, the exhibits were all in place and were formally opened to the public.

In the act authorizing the Exposition special provision was made for the construction of a separate building for the exhibits of the United States Government, at a cost of \$400,000. About 22,000 square feet of floor space were assigned to the Smithsonian Institution and National Museum at the south center of the building.

Before closing these statements I feel it my duty again to allude to the overcrowded condition of the halls of the present Museum building. This has been temporarily alleviated to some extent by the transmission of a large number of specimens from several departments of the Museum to the World's Columbian Exposition, but at the close of the Exposition these objects will be returned. Some provision must also be made for the objects which were acquired especially for the Exposition, as well as for material which will doubtless be presented to the United States by foreign governments and private exhibitors.

I have already called attention to the large number of specimens, now in the storerooms, which have never yet been provided for, and which are in danger of deteriorating, owing to the impossibility of properly caring for them. I am aware that the burden of these remarks has become an annual repetition, but I feel it my duty to continue to make these representations until Congress, upon whom the responsibility falls, shall erect an additional Museum building, or at least fire-proof storage-sheds.

I must again call attention to the need of larger appropriations for the current work. The number of visitors and the demands of the public are constantly increasing, and more money is necessary in order to carry on legitimate work in a business like and effective manner. The clerical employes are paid less than in the Executive Departments, and many of them leave after a short period of service, to the serious detriment of the Museum, which is compelled to train new clerks.

In the matter of heating and lighting, to which I called special attention in my last report, I trust that the full amount asked for, including the cost of new heating apparatus, which I have estimated at \$4,000, will be allowed by Congress. I may add that much sickness has occurred during previous winters owing to the impossibility of keeping all the offices in the building properly heated with the small amount of coal which could be purchased.

APPENDIX II.

REPORT OF THE DIRECTOR OF THE BUREAU OF ETHNOLOGY FOR THE YEAR ENDING JUNE 30, 1893.

SIR: I have the honor to submit the following report on the work of the Bureau under my charge during the fiscal year ending June 30, 1893. In recent years the researches of the Bureau have been largely topical and carried forward along lines representing the chief natural divisions of ethnologic science. The report is arranged by these subjects of investigation.

PICTOGRAPHY AND SIGN LANGUAGE.

Researches concerning the pictography and sign language of the native American tribes were continued by Col. Garriek Mallery, who spent a part of the year in the field in northern New England and contiguous territory in special work among the survivors of the Abnaki, Miemac, and other Algonquian tribes. The work resulted in substantial additions to knowledge of the picture writing and gesture speech among these people. During the greater part of the year Col. Mallery was occupied in the office first in preparing and afterward in revising and correcting the proof sheets of his extended report entitled "Picture writing of the American Indians," which forms the greater part of the tenth annual report of the Bureau. This elaborate treatise is a practically exhaustive monograph on the subject to which it relates. The plates and text illustrations, which together comprise nearly fourteen hundred figures, were collected with care and represent the aboriginal picture writing of all portions of the country with fidelity, while the significance and relations of the glyphs are discussed in detail in the text.

During the later portion of the year, in intervals of the work of proof revising, Col. Mallery continued the collection and arrangement of material relating to the sign language of the American aborigines. A preliminary treatise on this subject was published in one of the early reports of the Bureau; but since that time, partly through the stimulus to study of the habits and customs of our native tribes afforded by that publication, a large amount of additional material has been obtained. It is the purpose to collate and discuss this material in a final monograph, which will be, it is believed, even more comprehensive than that on pictography, and Col. Mallery has made satisfactory progress in this work.

Dr. W. J. Hoffman, who has for some years been associated with the work on pictography and sign language, was occupied during the greater part of the year in collateral researches relating to the ceremonies of a secret society (the "Grand Medicine Society") of the Menomoni Indians of Wisconsin. Beginning with the study of the pictographs and gestures of these Indians he gradually extended his investigations to other characteristics of the tribe, and for three years in succession attended the initiation of candidates into their most important secret society, and was thus enabled to obtain the archaic linguistic forms used only in the language employed in the esoteric ritual. The data collected were subsequently collated with a view to publication. Some attention was also given to linguistic matter, including gesture speech, collected among the Absaroka Indians in Montana and the Leech lake band of Ojibwa Indians in Minnesota.

ARCHEOLOGY.

Archeologic researches were actively continued by Prof. W. H. Holmes, with several collaborators and assistants, in different eastern States and in the interior. The work in eastern United States has been notably rich in results of scientific value. Prof. Holmes examined in detail the novaculite quarries of Arkansas, the pipestone quarries of Minnesota, and the ancient copper mines of Isle Royale, Mich. He also made important studies at various points in the valleys of Potomac, Genesee, and Ohio rivers, and his surveys and examinations in the Delaware valley, particularly about Trenton, were especially extended. At the last-named locality advantage was taken of the excavation of a broad and deep trench parallel with the river front at Trenton to study carefully the late glacial gravels commonly supposed to yield human relics. For a period of six weeks the excellent exposures made in this trench, 25 to 35 feet deep, were constantly watched by Prof. Holmes and Mr. William Dinwiddie, without, however, the finding of a single artificial object in the previously undisturbed gravels. This negative result is believed to be of great importance to American archeology. Special examinations, frequently requiring excavations, were made of the ancient soapstone quarries of the District of Columbia and in Virginia, Mr. Dinwiddie and Mr. Gerard Fowke aiding in the work; and toward the close of the year Mr. De Lancey W. Gill, of the U. S. Geological Survey, was detailed to make an examination of the ancient mica mines of North Carolina. Valuable collections of material representing aboriginal arts and industries grew out of this work.

In December Prof. Holmes was placed in charge of the exhibit of the Bureau of Ethnology for the World's Columbian Exposition at Chicago, and several months were occupied mainly in preparing, classifying, labeling, and arranging the exhibit, which includes (1) a series of collections illustrating aboriginal quarrying, mining, and implement-making industries; (2) various collections of ethnologic material made chiefly by collaborators of the Bureau; and (3) a series of life-size figures illustrating the domestic life, arts, and industries of the aborigines. It is a pleasure to observe that this exhibit attracted great attention among visitors to the Fair. Messrs. H. W. Henshaw, James Mooney, F. H. Cushing, and Gerard Fowke aided in the preparation of this exhibit.

At intervals throughout the year Prof. Holmes continued researches concerning the development of the shaping arts. Hitherto, American archeologists have in general been content to accept the classification of prehistoric peoples into culture stages based on the products of art work in stone, the classification being derived from European studies. During the last decade different archeologists have devoted much attention to the development of pristine culture as indicated by the artificial stone implements, weapons, and other objects found in many parts of this country, and have come to question the applicability of the European classification. While the investigation can not be regarded as complete, it is worthy of note that a large body of data has been brought together which seem to afford a basis for an indigenous classification of primitive American art products. This classification will, it is believed, eventually give character to that branch of American archeology which deals with art in stone.

Mr. Cosmos Mindeleff continued his study of the Pueblo relics and prepared an elaborate treatise on the subject for the press. This work, under the title "Aboriginal Remains in the Valley of the Rio Verde," is now completed and forms part of the thirteenth annual report. It illustrates in detail the architecture and various industrial arts recorded in the ruined cities of pre-Columbian tribes in the Southwest.

• In addition to the surveys and researches already noted, Mr. Gerard Fowke was employed for several months in archeologic explorations in Ohio. He was able to obtain much valuable material.

INDIAN MOUNDS.

The researches concerning the ancient Indian mounds distributed over many portions of the country, particularly the Mississippi Valley, have been continued by Dr. Cyrus Thomas. The chief work during the year has been the preparation of matter for publication and the revision of proofs of text and illustrations. The principal results of Dr. Thomas's researches are incorporated in a monograph of over 700 pages in the eleventh annual report. Several minor papers relating to different classes of articles collected from mounds also are in various stages of preparation, two being ready for publication.

In addition to his special work on the Indian mounds, Dr. Thomas was able to devote some time to the study of certain Mexican codices of exceptional archeologic interest. Considerable progress has been made in analyzing the characters of the Maya codices, and it is believed that these highly significant inscriptions may ultimately be deciphered by means of the methods devised and pursued by him.

No field work was conducted in this branch of the Bureau during the year.

SOCIOLOGY.

The work on sociology of the American Indians was continued by Mr. H. W. Henshaw. The earlier part of the year was spent in collecting sociologic and linguistic materials among the Indians of Butte, Mendocino, and San Diego counties, California. Early in 1893 Mr. Henshaw was unfortunately compelled by ill health to ask for indefinite leave of absence.

Mr. James Mooney spent the greater part of the year in the field collecting information concerning the Sioux ghost dance, and concerning the habits, customs, and social relations of the Kiowa and other tribes, visiting the Sioux Indians at Pine Ridge, S. Dak., the Shoshoni and northern Arapaho in Wyoming, and the Cheyenne, southern Arapahos, Kiowa, Comanche, and associated tribes in Oklahoma. In addition to valuable literary material, he made important collections of objects representing aboriginal life, including a series of Kiowa shield models with illustrative pictography affording data for a study of primitive heraldry, and three important calendars.

In December Mr. Mooney was commissioned to make collections among the Navajos and Moquis of New Mexico and Arizona for exhibition at the World's Fair. This work resulted in a remarkable collection of unique material from two of our most interesting native tribes, including the products of industrial arts, costumery, etc., as well as the photographs and materials needed for preparing and exhibiting a series of groups of life-sized figures illustrating domestic life, industries, and ceremonies. In addition an unprecedentedly extensive collection of Indian food products was obtained for the National Museum.

LINGUISTICS.

Linguistic researches were continued by Rev. J. Owen Dorsey, Dr. Albert S. Gatschet, and Mr. J. N. B. Hewitt. Mr. Dorsey continued his investigations in connection with the report on Indian synonymy, making a thorough study of the Catawba tribes and their habitats. He also resumed work on the Biloxi language, at first using the material collected during the previous year, arranging the Biloxi verbs in fourteen conjugations, making a list of Biloxi onomatopoes, and compiling a Biloxi-English vocabulary of about two thousand entries together with a catalogue of Biloxi roots. For the purpose of carrying this investigation to completion he visited Leconte, La., during the winter and spent two months with the survivors of this interesting tribe. In addition he practically finished the work of editing the manuscript of Riggs, "Dakota Grammar, Texts and Ethnography," which constitutes Volume IX of the series of Contributions to North American Ethnology. Proofs of this work, which is about to leave the press, were revised during the latter portion of the year.

The earlier part of the year was spent by Dr. Gatschet in the study of the Wichita

language at the Educational Home for Indian boys in Philadelphia. Special attention was given to the Wichita verb, which, like the verb of all the Caddoan languages, is highly complex in its inflections and in the permutability of its consonants. From October 1 up to the end of April Mr. Gatschet was occupied in the study of the Peoria, Shawnee (or Shawano), Arapaho, and Cheyenne languages in Indian Territory. Eight weeks were devoted to the Peoria language, during which period over three thousand terms and a corresponding number of phrases and sentences were collected and revised. This study is deemed of exceptional interest, since no texts of the Peoria language are known to have appeared in print.

The Shawnee was the language next taken up. Assisted in the field by good interpreters, Dr. Gatschet obtained copies and reliable material in texts of the phraseology and terms of the Shawnee language, a number of verbal and nominal paradigms, and a choice selection of instances showing the multiplicity of duplication.

Subsequently he took up the Arapaho and Cheyenne languages. Both are nasalizing and are spoken in several dialects differing but little from each other. Ample collections were made of lexical and phraseological material, with texts and some poetic specimens. The ethnographic study of these genuine prairie Indians is highly interesting, since they have had but a few years of intercourse with the white man and his civilizing, as well as corrupting, influences.

Mr. Hewitt continued his work on the Iroquoian languages, with which he is thoroughly familiar. He was able to ascertain and formulate the principles or canons governing the number, kind, and position of notional stems in symphrases, or word-sentences. Six rules are formulated which establish and govern the morphologic ground plan of words and word-sentences. These are as follows:

First. The simple or the compound stem of a notional word of a word-sentence may not be employed as an element of discourse without a prefixed simple or complex personal pronoun, or sign or flexion denotive of gender, the prefixion of the latter taking place with nouns only.

Second. Only two notional stems may be combined in the same word-sentence, and they must belong respectively to different parts of speech.

Third. An adjective-stem may not combine with a verb-stem, but it may unite with the formative *thá'*, to make or cause, or with the inchoative *ç*.

Fourth. The stem of a verb or adjective may combine with the stem of a noun, and such stem of a verb or adjective must be placed after and never before the noun-stem.

Fifth. A qualificative or other word or element must not be interposed between the two combined stems of compound notional words, nor between the simple or compound notional stem and its simple or complex pronominal prefix.

Sixth. Derivative and formative change may be effected only by the prefixion or suffixion of suitable flexions to the morphologies fixed by the foregoing rules or canons.

Mr. Hewitt also continued his general study of the Iroquoian languages described in previous reports, and collected additional material relating to the manners, customs, and history of the Iroquis Indians, chiefly by translation and abstraction from the Jesuit relations and accounts of the early French explorers. He also continued work on the Tuskarora-English dictionary and grammar.

MYTHOLOGY.

The researches in mythology, by Mr. Frank Hamilton Cushing and Mrs. Matilda Coxe Stevenson, were continued throughout the year. Mr. Cushing was occupied chiefly in arranging and collating material previously collected, with a view to publication. An important result of his work is the demonstration of the fact that the mythic concepts, which form so large a part of the intellectual life of primitive peoples are greatly modified by the bodily organs and functions exercised in their expression. In some cases this relation between organ or function on the one hand and concept on the other is so intimate as to justify the ascription of the modern con-

cept to dual causes, of which the first is intellectual, while the hardly less essential second cause is physiologic; *e. g.*, it may be shown conclusively that the decimal system forming the basis of the arithmetic of certain southwestern tribes is essentially indigenous and has grown up through successive generations from counting on the fingers in certain definite ways. This relation between concepts and physiologic structure is especially significant in its bearing on the development of primitive mythology.

Mrs. Stevenson was occupied during a part of the year in revising for the press her report entitled "The Sia," which forms the leading paper of the twelfth annual report of the Bureau, now in the hands of the printer. She was also engaged for several months in the preparation of a memoir on the secret societies and ceremonies of the Zuñi Indians. Mrs. Stevenson's researches on these southwestern tribes have not only resulted in important contributions to knowledge of the primitive beliefs by which the daily life of these peoples was governed, but have also thrown light on the migrations and ethnic relations of their ancestors. The monograph on this subject, which is illustrated by numerous graphic representations, is approaching completion.

BIBLIOGRAPHY.

The work on bibliography of native American languages was continued by Mr. James C. Pilling. Two numbers of the series of bibliographies were issued as bulletins of the Bureau during the year, another was sent to press, and a fourth was nearly completed in manuscript. The later proofs of the sixth of the series, which relates to the Athapaskan languages, were revised early in the year. The work was subsequently issued as a bulletin of 138 pages, embracing 544 titular entries with 4 facsimile reproductions. Although the publication was not distributed until spring of the present calendar year, it has already been favorably noticed in scientific journals in this and other countries; and the critical reviews show that the students of our native languages place this work by Mr. Pilling on the same high plane accorded the previous volumes of the series.

The bibliography of the Chinookan languages (including the Chinook jargon) was sent to press in October and proof revision was finished in April. In the compilation of this bibliography much attention was given to the origin and growth of the Chinook jargon, or "trade language," of the northwestern coast, which has come to be an international dialect, affording the established means of communication between the whites and the several native tribes occupying the region between the State of Washington and Alaska, whose languages are many and diverse. While this bibliography (the seventh of the series) comprises but 94 pages and includes only 270 titular entries, it is believed that it will prove no less valuable to linguistic students than the earlier numbers, since it is substantially a record of a dead language, there being but one man now living who fully understands the tongue on which the linguistic relations of the family rest. The edition of this bulletin was delivered by the Public Printer in May.

The manuscript of the bibliography of the Salishan languages was sent to press in March, and proof revision is in progress. This work exceeds in volume the Chinookan bibliography, and, like that, deals with the records of one of the highly interesting group of native tongues of our Pacific region, which, though doomed to early extinction, are among the most important sources of information concerning the development of language.

Toward the close of the year Mr. Pilling was occupied in preparing for the press the bibliography of the Wakashan languages, the ninth number of the series, which is now well advanced.

The value of the several bibliographies has been greatly enhanced, and their preparation has been materially facilitated through the cooperation of linguistic students in different parts of the country. Special acknowledgments are due Mr. Horatio Hale, the well-known philologist, and Mr. J. K. Gill, author of a dictionary

of the Chinook jargon, for aid in the preparation of Chinookan bibliography; and Mr. Pilling acknowledges equal obligations to the Rev. Myron Eells and Dr. Franz Boas for information concerning the Chinookan and Salishan languages.

SYNONYMY OF INDIAN TRIBES.

The preparation of this work, which has engaged the attention of nearly all the collaborators of the Bureau at various times, is well advanced. During the year Messrs. H. W. Henshaw, F. Webb Hodge, James Mooney, and J. Owen Dorsey have contributed to the work. The portions of the synonymy relating to the tribes of the following stocks are ready for publication:

Attacapan, Beothukan, Kalapooian, Karankawan, Kusan, Lutuamian, Muskhoegan, Natchesan, Skittagetan, Timuquanan, Tonikan, Uchean, Yakonan, and Yuman.

In addition, the Algonquian and Iroquoian families—two of the largest and most important—require comparatively little elaboration by Mr. Mooney (to whom these stocks were originally assigned) to make them ready for press.

When his other duties permitted Mr. Hodge devoted attention to the elaboration of material pertaining to the Piman family, as well as that of the Pueblo stocks (Zuñian, Keresan, Tañean, and the Tusayan division of the Shoshonean). Very little work is now required to finally complete for publication the material relating to these tribes. In addition, Mr. Hodge introduced into the descriptions formerly made of some twenty stocks (principally in California) a large body of new material made known by recent investigators.

PSYCHOLOGY.

Within recent years it has come to be recognized by many ethnologists that the mythic concepts, and through these the social institutions, of primitive peoples are dependent on a limited number of factors, including (1) individual and tribal environment and (2) individual and collective modes and habits of thought. Now the first of these factors has received the attention of nearly all investigators, while the second has received much less consideration and is frequently ignored. Accordingly, it has been thought desirable to undertake the investigation of intellectual method for the purpose of developing the principles of psychology, and thus affording a more definite basis for the researches in mythology and sociology. To this subject the Director has devoted a considerable part of the year, and a tentative system of psychology which will, it is believed, prove a useful guide for further researches has been formulated.

EXPLORATION.

The Director spent several weeks in ethnologic exploration in the Northern Pacific slope. The territory lying between the Sierra Nevada Mountains and the Pacific is of exceptional value to ethnologists by reason of the remarkable number of independent linguistic stocks crowded into a relatively small area; three-fourths of the distinct groups of peoples in this country, and fully half of all known on the Western Hemisphere, are found in this locality. The northern part of the tract has never been explored by students; and in the hope of discovering additional stocks among the remaining tribes, and in the hope of gaining additional knowledge concerning the origin of this remarkable diversity of languages, an exploratory trip was planned. The results of the observations are incorporated in reports now in course of preparation for the press. Mr. Henshaw, in southern California, and Mr. Mooney, in the northern Rocky Mountain region, also penetrated areas and encountered Indians not previously seen by scientific students.

MISCELLANEOUS WORK.

As incidentally noted in preceeding paragraphs, much time and thought have been given to the installation of an ethnologic exhibit in the World's Columbian Exposition at Chicago. This exhibit occupies the southern portion of the Govern-

ment building. It comprises a large amount of material of popular as well as scientific interest, derived from various portions of the country, a considerable part of this material having been collected or prepared especially for the Exposition. Most of the collaborators of the Bureau have contributed directly or indirectly to this exhibit.

The work of the modeling department has been continued. The chief work has lain in the restoration and repair of models previously constructed and exhibited at the expositions in New Orleans and Madrid. A number of new models and several replicas of models already constructed have, however, been executed, chiefly for use in the Columbian Exposition.

During the year an exceptional number of applications for definite information concerning our native tribes have been received from the publishers of encyclopedias, dictionaries, physical geographies, and other standard works, and in view of the educational value of these publications and the manifest public advantage to be gained from the diffusion of the results of the latest scientific researches, it has been deemed important to respond to such applications as fully as possible. Much information has been disseminated in this way during the year, and several encyclopedia articles have been prepared by the director and different collaborators of the Bureau.

ILLUSTRATIONS.

The work connected with the illustration of reports has been continued under the supervision of Mr. DeLancey W. Gill, chief of the division of illustrations of the Geological Survey, the actual labor of executing drawings being performed in large part by Miss Mary Irvin Wright and Miss Mary M. Mitchell. Most of the work done by the former artist is highly elaborate, comprising drawings of pueblo life and ceremonials and representations of scenes in the ceremonials of the Sioux ghost dance. The chief work of the latter has been the preparation of drawings of Indian implements, principally objects of stone. Two hundred and fifty-seven original drawings designed for reproduction by various processes were executed during the year.

One thousand three hundred and forty-four engraved proofs have been received from the Public Printer during the fiscal year and have been examined, revised or approved, and returned. The printed editions of all chromolithographs used in the publications of the Bureau have also been examined and the imperfect sheets rejected.

The photographic work of the Bureau has been ably directed, as in previous years, by Mr. J. K. Hillers. The following statement includes the work done in the photographic laboratory during the year:

Size.	Negatives.	Prints.
28 by 34 inches.....	42	137
22 by 28 inches.....	5	10
20 by 24 inches.....	26	83
14 by 17 inches.....	65	309
11 by 14 inches.....	42	85
8 by 10 inches.....	26	172
5 by 8 inches.....		629
4 by 5 inches.....		1,153

I have the honor to be, yours, with respect,

J. W. POWELL,
Director.

MR. S. P. LANGLEY,
Secretary of the Smithsonian Institution.

APPENDIX III.

REPORT OF THE CURATOR OF EXCHANGES FOR THE YEAR ENDING JUNE 30, 1893.

SIR: I have the honor to present the following brief report, chiefly statistical, of the operations of the Bureau of International Exchanges for the fiscal year ending June 30, 1893:

TABULAR STATEMENT OF THE WORK OF THE BUREAU.

The work of the bureau for the year is succinctly given in the annexed table, prepared in a form adopted in preceding reports:

Transactions of the Bureau of International Exchanges during the fiscal year 1892-'93.

Date.	Number of packages received.	Weight of packages received.	Ledger accounts.				Domestic packages sent.	Invoices written.	Cases shipped abroad.	Letters received.	Letters sent.
			Foreign societies.	Domestic societies.	Foreign individuals.	Domestic individuals.					
1892.											
July.....	7,469	19,228								162	147
August.....	13,635	15,028								216	299
September.....	14,592	14,725								157	173
October.....	5,905	17,342								153	146
November.....	5,508	18,599								150	126
December.....	11,994	16,449								139	288
1893.											
January.....	5,687	12,883								165	147
February.....	6,038	20,305								145	170
March.....	7,379	22,894								187	195
April.....	5,344	12,023								166	158
May.....	11,741	20,328								202	243
June.....	5,771	11,124								173	227
Total.....	101,063	200,928	6,896	2,414	8,554	5,010	29,454	19,996	878	2,013	2,259
Increase over 1891-'92.....	4,036	*—25,589	692	370	614	486	3,854	*—3,140	*—137	*—310	*—493

* Decrease.

For comparison with previous years I add a tabular statement from 1886 to 1893, inclusive, by which the growth of the service is made apparent:

	1886-'87.	1887-'88.	1888-'89.	1889-'90.	1890-'91.	1891-'92.	1892-'93.
Number of packages received.	61,940	75,107	75,966	82,572	90,666	97,027	101,063
Weight of packages received.	141,263	149,630	179,928	202,657	237,612	226,517	200,928
Ledger accounts:							
Foreign societies.....	7,396	4,194	4,466	5,131	5,981	6,204	6,896
Foreign individuals.....		4,153	4,699	6,340	7,072	7,910	8,554
Domestic societies.....	2,165	1,070	1,355	1,431	1,588	2,044	2,414
Domestic individuals.....		1,556	2,610	3,100	4,207	4,524	5,010
Domestic packages sent.....	10,294	12,301	17,218	13,216	29,047	26,000	29,454
Invoices written.....	15,288	13,525	14,095	16,948	21,923	23,136	19,996
Cases shipped abroad.....	692	663	693	873	962	1,015	878
Letters received.....	1,131	1,062	1,214	1,509	2,207	2,323	2,013
Letters written.....	1,217	1,804	2,050	1,625	2,417	2,752	2,259

EXPENSES.

The expense of the Exchange Bureau are met in part by direct appropriation by Congress and in part by appropriations made to Government Departments or Bureaus, either in their contingent funds or in specific terms for repayment to the Smithsonian Institution of a portion of the cost of transportation. In 1878 the Board of Regents established a charge of 5 cents per pound weight for the publications sent out or received by the various Government bureaus, this charge being necessary to prevent an undue tax upon the resources of the Institution, as the appropriations made by Congress have never been sufficient to meet the entire cost of the service. For similar reasons it has been found necessary to make a charge of the same amount to State institutions, and from these a further small sum has been received.

The appropriation made by Congress for the fiscal year 1892-'93 was in the following terms: "For expenses of the system of international exchanges between the United States and foreign countries, under the direction of the Smithsonian Institution, including salaries or compensation of all necessary employes, twelve thousand dollars," which amount was supplemented by a deficiency appropriation of \$5,000.

The receipts and disbursements by the accounting officer of the Smithsonian Institution on account of international exchanges, under date of July 1, 1893, covering the fiscal year immediately preceding, were as follows:

RECEIPTS.

Direct appropriations by Congress.....	\$17,000.00
Repayments to the Smithsonian Institution from United States Government Departments.....	1,396.64
State institutions.....	63.85
Repayment of freight advanced for New South Wales government board for international exchanges.....	23.50
Total.....	18,483.99

EXPENSES.

For—	From specific Congressional appropriations.	From other sources.
Salaries and compensations.....	\$13,872.52	
Freight.....	1,805.01	
Packing boxes.....	441.40	
Printing.....	217.85	
Postage.....	150.00	
Stationery.....	512.98	
	16,999.76	\$1,518.49
Total.....		18,518.25

The foregoing table shows that the entire amount received from Government bureaus and other sources was \$1,483.99, making the sum practically available for the specific purpose of exchanges \$18,483.99, while the expenses have amounted to \$18,518.25, the deficiency of \$34.26 being made up from the Smithsonian fund.

For the year 1892-'93 an estimate for the entire expense of the service of \$23,000 was submitted, this sum being intended to include in a single appropriation various

small items in different appropriation bills, and also an item of \$2,000 to cover the expense of an immediate exchange of parliamentary documents with the countries entering into the treaty of Brussels in 1886. To this latter treaty for the immediate exchange of the Congressional Record no effect has yet been given by reason of lack of funds. The amount originally appropriated for the service of the year 1892-'93 was \$12,000, as stated above, and this was subsequently increased by a deficiency appropriation of \$5,000 upon urgent representation of the need of this further amount to carry the work through the year.

CORRESPONDENTS.

The new list of correspondents begun upon small ledger cards, January 1, 1892, has proved of great convenience, and it is only by introducing labor-saving devices in the arrangements for handling the records that it has been at all possible to meet the growth of the service with the smaller clerical force.

The number of new ledger cards on July 1, 1892, was 9,808, and on June 30, 1893, 16,340, classified as follows:

	New list, since January 1, 1892.		Entire list.	
	Foreign.	Domestic.	Foreign.	Domestic.
Societies and institutions	6,670	1,775	6,896	2,414
Individuals.....	5,308	2,587	8,554	5,010
Total	11,978	4,362	15,450	7,424

INTERNATIONAL EXCHANGE OF OFFICIAL DOCUMENTS.

Under the treaty of Brussels of 1886, the text of which was given in full in the report of the curator of exchanges for 1887-'88, the exchange of the official publications of the United States Government with other countries has been continued by the Institution, and it now forms a very large proportion of the bureau's work.

The entire number of publications sent abroad during the year under the provision of the act of Congress of March 2, 1867, and of the treaty above referred to was 31,850, and there have been received in return 5,196 packages. The United States Government Departments have forwarded to their correspondents abroad 16,074 packages, and have received in return 12,922 packages. The total number of exchanges for Government libraries has therefore been 18,118 packages received and 47,924 packages sent abroad, a total of 66,012 packages, or about 65 per cent of the entire number handled.

The very inadequate return for the great number of documents sent out is in part undoubtedly due to the fact that no other country publishes on such a lavish scale as our own. Direct solicitation made by a special representative to the governments with which we are in correspondence would also probably result in a considerable increase to the Library of Congress.

The exchange on account of Government bureaus is shown in detail in the following table:

Statement of Government exchanges during the year 1892-'93.

Name of bureau.	Packages—		Name of bureau.	Packages—	
	Received for.	Sent by.		Received for.	Sent by.
Smithsonian Institution	11, 136	3, 616	U. S. General Land Office.....	4	.....
Astro-physical Observatory	7	1	U. S. Geological Survey	406	949
Bureau of Ethnology.....	107	916	U. S. Hydrographic Office.....	74	.....
Bureau of International Exchanges.....	8	.....	U. S. Indian Affairs Office.....	3	.....
National Zoological Park	1	.....	U. S. Interior Department.....	25	295
U. S. Agricultural Department.....	130	19	U. S. Interstate Commerce Commission	1	.....
U. S. Army Medical Museum	3	.....	U. S. Light-House Board.....	2	1
U. S. Botanic Garden.....	3	.....	U. S. Marine-Hospital Service.....	6	.....
U. S. Bureau of Education	63	.....	U. S. Mint	1	.....
U. S. Bureau of Navigation.....	2	.....	U. S. National Academy.....	64	989
U. S. Bureau of Ordnance, Navy Department	1	.....	U. S. National Board of Health.....	1	.....
U. S. Bureau of Ordnance, War Department.....	4	.....	U. S. National Museum.....	161	6, 103
U. S. Bureau of Statistics, Treasury Department	25	.....	U. S. Nautical Almanac Office.....	17	141
U. S. Census Office	9	6	U. S. Naval Observatory.....	106	1, 200
U. S. Coast and Geodetic Survey.....	61	19	U. S. Navy Department.....	1	.....
U. S. Commissioner of Weights and Measures.....	1	.....	U. S. Patent Office.....	38	573
U. S. Comptroller of the Currency	2	.....	U. S. Public Printer.....	.....	31, 850
U. S. Congressional Library.....	5, 196	.....	U. S. Senate.....	1	.....
U. S. Department of Justice.....	1	.....	U. S. Signal Service.....	39	.....
U. S. Department of Labor.....	18	3	U. S. State Department.....	14	.....
U. S. Engineer Office	34	98	U. S. Surgeon-General's Office (Army).....	170	554
U. S. Entomological Commission.....	7	.....	U. S. Surgeon-General's Office (Navy).....	9	.....
U. S. Fish Commission	70	246	U. S. Treasury Department.....	7	.....
			U. S. War Department.....	14	219
			U. S. Weather Bureau.....	65	126
			Total	18, 116	47, 924

EFFICIENCY OF THE SERVICE.

I beg to call attention to the unsatisfactory state of the exchange relations with several countries, a condition of affairs which can perhaps in some instances be remedied by proper representations through diplomatic channels. The transmission of exchanges to Greece has been entirely suspended, a letter having been received from the librarian of the United National and University Libraries, formerly acting as the medium for distributing publications, requesting that with the exception of their own exchanges no further boxes be forwarded, on account of the expense attending the distribution of the packages. Correspondence has been opened with a view to establishing a new exchange relation, but so far without success. All transmissions to Brazil and Chile were for a time suspended, owing to the unsettled condition of these countries. With Mexico our exchange relations are also extremely unsatisfactory. Correspondents in Nicaragua meet with what would seem to be unreasonable delay in receiving packages addressed to them, and I regret to state that the Government authorities at Calcutta have declined to receive and dispatch packages addressed to other than Government officials. On the other hand, very efficient international exchange bureaus are now under Government auspices in New South Wales and Uruguay.

Referring to clerical details of the office work, it seems desirable to keep before

the minds of Smithsonian correspondents the system of accounting for the material, often of considerable value, that passes through the exchange office.

Under the name of each individual or society sending or receiving a package through the exchange bureau, an account of all such packages is kept, with the date of transmission and of acknowledgment. It was found possible to abbreviate somewhat the records made upon the cards used for the purpose, and a much smaller card was brought into use on January 1, 1892, thereby greatly facilitating the work of the record room. A further saving was effected by giving the "invoice numbers" only for the packages upon the receipt cards transmittal with the packages, as a means of identification. Attention is called by a printed notice upon the outside of the package to this invoice number, which must be carefully compared with that upon the receipt card, and the latter is to be returned promptly. All these receipts are carefully arranged and filed.

Only by such abbreviation of the records was it possible to carry the exchange work through the year in the face of a curtailed appropriation by Congress. The clerical force was reduced by dropping three clerks and two packers from the roll, though at the end of the year, when the deficiency appropriation became available, a part of the force was temporarily restored, to be again reduced when the fiscal year closed.

Notwithstanding these reductions 4,036 more packages were handled during 1892-'93 than in the previous year, and at the end of June only 73 packages remained on hand.

I take much pleasure in bearing witness to the efficiency of the employés in the exchange office and in expressing appreciation of their efforts to keep up with the added volume of work in spite of the unavoidable reduction in the force to handle it, and I beg leave to call to your notice the careful attention to the interests of the Institution on the part of its special agents abroad, Dr. Felix Flügel, in Leipzig, and Messrs. William Wesley & Son, in London.

Grateful acknowledgments are also due to the following transportation companies and others for their continued liberality in granting the privilege of free freight or in otherwise assisting in the transmission of exchange parcels and boxes, while to other firms thanks are due for reduced rates of transportation in consideration of the disinterested services of the Institution in the diffusion of knowledge.

LIST OF SHIPPING AGENTS AND CONSULS TO WHOM THE EXCHANGE SERVICE IS
INDEBTED FOR SPECIAL COURTESIES.

d'Almeirim, Baron, Royal Portuguese consul-general, New York.

American Board of Commissioners for Foreign Missions, Boston.

Anchor Steamship Line (Henderson & Bro., agents), New York.

Atlas Steamship Company (Pim, Forwood & Co.), New York.

Bailey, H. B., & Co., New York.

Börs, C., consul-general for Sweden and Norway, New York.

Boulton, Bliss & Dallett, New York.

Calderon, Climaco, consul-general for Colombia, New York.

Cameron, R. W., & Co., New York.

Baltazzi, X., consul-general for Turkey, New York.

Compagnie Générale Transatlantique (A. Forget, agent), New York.

Cunard Royal Mail Steamship Company (Vernon H. Brown & Co., agents), New York.

Espriella, Justo R. de la, consul-general for Chile, New York.

Hamburg-American Packet Company (R. J. Cortis, manager), New York.

Hensel, Bruckmann & Lorbacher, New York.

Mantez, José, consul-general for Uruguay, New York.

Muñoz y Espriella, New York.

Navigazione Generale Italiana (Phelps Bros. & Co.), New York.
 Netherlands American Steam Navigation Company (W. H. Vanden Toorn, agent), New York.
 North German Lloyd (agents: Oelrichs & Co., New York; A. Schumacher & Co., Baltimore).
 Obarrio, Melchor, consul-general for Bolivia, New York.
 Pacific Mail Steamship Company (H. J. Bullay, superintendent), New York.
 Pioneer Line (R. W. Cameron & Co.), New York.
 Perry, Ed., & Co., New York.
 Pomares, Maria L. O., consul-general for Salvador, New York.
 Red Star Line (Peter Wright & Sons, agents), New York and Philadelphia.
 Röhl, C., consul-general for Argentine Republic, New York.
 Royal Danish Consul, New York.
 Ruiz, Domingo L., consul-general for Ecuador.
 Stewart, Alexander, consul-general for Paraguay, Washington, D. C.
 Toriello, Enrique, consul-general for Guatemala, New York.
 White Cross Line of Antwerp (Funch, Edye & Co.), New York.

LIST OF THE CORRESPONDENTS OF THE SMITHSONIAN THROUGH WHOM INTERNATIONAL EXCHANGES ARE TRANSMITTED.

Algeria: Bureau Français des Échanges Internationaux, Paris, France.
 Argentine Republic: Museo Nacional, Buenos Ayres.
 Austria Hungary: Dr. Felix Flügel, No. 1, Robert Schumann Strasse, Leipzig, Germany.
 Brazil: Bibliotheca Nacional, Rio Janeiro.
 Belgium: Commission des Échanges Internationaux, Rue du Musée, No. 5, Brussels.
 Bolivia: University, Chuquisaca.
 British America: McGill College, Montreal, and Geological Survey Office, Ottawa.
 British Colonies: Crown Agents for the Colonies, London, England.
 British Guiana: The Observatory, Georgetown.
 Cape Colony: Colonial Secretary, Cape Town.
 China: Dr. D. W. Dobereck, Government Astronomer, Hongkong; for Shanghai: Zi-ka-wei Observatory, Shanghai.
 Chile: Museo Nacional, Santiago.
 Colombia (U. S. of): National Library, Bogota.
 Costa Rica: Instituto Fisico-geográfico Nacional, San Jose.
 Cuba: Dr. Frederico Poey, Calle del Rayo, 19, Habana, Cuba.
 Denmark: Kongelige Danske Videnskabernes Selskab, Copenhagen.
 Dutch Guiana: Surinaamsche Koloniaale Bibliotheek, Paramaribo.
 East India: Director General of Stores, India Office, London.
 Ecuador: Observatorio del Colegio Nacional, Quito.
 Egypt: Société Khédiviale de Géographie, Cairo.
 France: Bureau Français des Échanges Internationaux, Paris.
 Germany: Dr. Felix Flügel, No. 1, Robert Schumann Strasse, Leipzig.
 Great Britain and Ireland: William Wesley & Son, 28 Essex street, Strand, London.
 Guatemala: Instituto Nacional de Guatemala, Guatemala.
 Guadeloupe: (*See France.*)
 Haiti: Secrétaire d'État des Relations Extérieures, Port-au-Prince.
 Honduras: Bibliotheca Nacional, Tegucigalpa.
 Iceland: Icelands Stiptisbokasáfn, Reykjavík.
 Italy: Biblioteca Nazionale Vittoria Emanuele, Rome.
 Japan: Minister of Foreign Affairs, Tokyo.
 Java: (*See Holland.*)
 Liberia: Liberia College, Monrovia.
 Madeira: Director-General, Army Medical Department, London, England.
 Malta: (*See Madeira.*)

Mauritius: Royal Society of Arts and Sciences, Port Louis.
 Mozambique: Sociedad de Geografia, Mozambique.
 Mexico: Packages sent by mail.
 New Caledonia: Gordon & Gotch, London, England.
 Newfoundland: Postmaster-General, St. Johns.
 New South Wales: Government Board for International Exchanges, Sydney.
 Netherlands: Bureau Scientifique Central Néerlandais, Den Helder.
 New Zealand: Colonial Museum, Wellington.
 Norway: Kongelige Norske Frederiks Universitet, Christiania.
 Paraguay: Government, Asunción.
 Peru: Biblioteca Nacional, Lima.
 Philippine Islands: Royal Economical Society, Manila.
 Polynesia: Department of Foreign Affairs, Honolulu.
 Portugal: Bibliotheca Nacional, Lisbon.
 Queensland: Government Meteorological Observatory, Brisbane.
 Roumania: (*See Germany.*)
 Russia: Commission Russe des Échanges Internationaux, Bibliothèque Impériale Publique, St. Petersburg.
 St. Helena: Director-General, Army Medical Department, London, England.
 San Salvador: Museo Nacional, San Salvador.
 Servia: (*See Germany.*)
 South Australia: General Post-Office, Adelaide.
 Spain: R. Academia de Ciencias, Madrid.
 Sweden: Kongliga Svenska Vetenskaps Akademien, Stockholm.
 Switzerland: Central Library, Bern.
 Tasmania: Royal Society of Tasmania, Hobarton.
 Turkey: American Board of Commissioners for Foreign Missions, Boston, Mass.
 Uruguay: Oficina de Depósito, Reparto y Canje Internacional, Montevideo.
 Venezuela: University Library, Caracas.
 Victoria: Public Library, Museum and National Gallery, Melbourne.

Transmission of exchanges to foreign countries.

Country.	Date of transmission, etc.
Argentine Republic . . .	February 1; June 17, 30, 1893.
Austria-Hungary	July 12, August 4, 16, September 3, 7, 23, October 7, November 11, 23, December 13, 1892; January 7, February 18, March 15, 22, April 1, 22, May 17, 31, June 7, 26, 1893.
Belgium	August 3, September 6, October 20, 1892; March 27, June 13, 24, 1893.
Bolivia	February 1, 1893.
Brazil	February 1, June 17, 1893.
British Colonies	September 9, October 12, November 15, 1892; January 19, February 25, April 8, 26, May 20, June 5, 27, 1893.
Cape Colony	October 22, 1892; June 22, 1893.
China	September 14, 1892; February 7, June 17, 1893.
Chile	February 1, June 17, 1893.
Colombia	February 1, June 17, 1893.
Costa Rica	February 4, June 20, 1893.
Cuba	February 4, April 10, June 20, 24, 1893.
Denmark	August 9, October 24, 1892; April 28, June 22, 1893.
Dutch Guiana	February 1, 1893.
East India	September 16, 1892; February 9, 1893.
Ecuador	February 1, June 17, 1893.
Egypt	December 23, 1892; June 22, 1893.
France and Colonies . . .	July 14, 21, August 5, 24, September 8, 22, October 10, 22, November 12, 26, December 2, 1892; January 14, February 23, March 1, 13, 24, April 4, 20, May 15, June 2, 29, 1893.

Transmission of exchanges to foreign countries—Continued.

Country.	Date of transmission, etc.
Germany	July 12, 20, August 4, 16, September 3, 7, 23, October 7, November 11, 23, December 5, 13, 1892; January 7, 26, February 17, 18, March 3, 15, 22, April 1, 22, May 17, 20, 31, June 7, 26, 1893.
Great Britain, etc.	July 8, 15, 21, August 6, 29, September 9, 28, October 12, November 15, 30, December 8, 1892; January 7, 19, February 25, March 15, 22, April 8, 26, May 20, June 5, 27, 1893.
Guatemala.....	February 4, June 20, 1893.
Haiti.....	February 4, June 20, 1893.
Honduras.....	February 4, June 20, 1893.
Italy.....	July 19, August 8, September 13, October 13, December 3, 1892; January 4, March 16, 24, May 1, June 9, 24, 1893.
Japan.....	September 14, 1892; June 24, 1893.
Mexico.....	(By registered mail.)
New South Wales	September 16, December 20, 1892; February 9, April 12, June 19, 1893.
Netherlands and Colonies.	July 22, September 29, 1892; February 16, May 3, June 10, 1893.
New Zealand	September 16, December 20, 1892; February 9, April 12, June 19, 1893.
Nicaragua	February 4, June 20, 1893.
Norway	August 11, October 18, 1892; February 17, June 13, 24, 1893.
Peru.....	February 1, June 17, 1893.
Polynesia.....	September 16, December 20, 1892; June 19, 1893.
Portugal.....	August 11, October 24, 1892; May 23, June 22, 1893.
Queensland	September 16, December 20, 1892; February 9, April 12, June 19, 27, 1893.
Roumania	(Included in Germany.)
Russia.....	July 15, August 2, September 13, October 17, December 10, 1892; March 17, 24, May 25, June 13, 24, 1893.
San Salvador	February 4, June 20, 1893.
Servia	(Included in Germany.)
South Australia.....	September 16, December 20, 1892; February 9, April 12, June 19, 1893.
Spain.....	September 29, 1892; March 24, May 25, June 24, 1893.
Sweden	July 15, August 11, September 13, October 17, December 10, 1892; March, 21, May 25, June 13, 24, 1893.
Switzerland	August 11, October 14, 1892; March 20, 24, May 26, June 24, 1893.
Tasmania.....	December 20, 1892; February 9, June 19, 1893.
Turkey.....	June 22, 1893.
Uruguay.....	February 1, June 17, 1893.
Venezuela	February 1, June 17, 1893.
Victoria	September 16, December 20, 1892; February 9, April 12, June 19, 1893.

* Shipments of U. S. Congressional publications were made on August 22, December 31, 1892, and May 17, 1893, to the governments of the following-named countries:

Argentine Republic.	Colombia.	Netherlands.	South Australia.
Austria.	Denmark.	New South Wales.	Spain.
Baden.	France.	New Zealand.	Sweden.
Bavaria.	Germany.	Norway.	Switzerland.
Belgium.	England.	Peru.	Tasmania.
Buenos Ayres, Province of.	Haiti.	Portugal.	Turkey.
Brazil.	Hungary.	Prussia.	*Uruguay.
Canada (Ottawa).	India.	Queensland.	Venezuela.
Canada (Toronto).	Italy.	Russia.	Victoria.
Chile.	Japan.	Saxony.	Württemberg.

* Uruguay was added to the list of exchanging governments and on September 27, 1892, the first transmission of 44 cases was made to that country.

The distribution of exchanges to foreign countries was made in 710 cases, representing 242 transmissions as follows:

Argentine Republic.....	8	Liberia	1
Austria-Hungary	40	Mexico (by mail).....	
Belgium	22	New South Wales	10
Bolivia	1	Netherlands.....	18
Brazil.....	6	New Zealand.....	6
British Colonies.....	11	Nicaragua.....	2
Cape Colony	3	Norway	10
China.....	3	Peru	2
Chile	6	Polynesia	4
Colombia	2	Portugal	7
Costa Rica.....	2	Queensland	11
Cuba	4	Roumania (included in Germany).....	
Denmark	8	Russia	34
East India	4	San Salvador.....	2
Ecuador.....	2	Servia (included in Germany).....	
Egypt	3	South Australia.....	5
France and Colonies.....	80	Spain	10
Germany.....	133	Sweden	21
Great Britain.....	127	Switzerland.....	18
Guatemala	2	Tasmania	3
Haiti	2	Turkey	2
Honduras	2	Uruguay	3
Italy.....	48	Venezuela.....	2
Japan.....	11	Victoria.....	9

RECAPITULATION.

Total Government shipments.....	168
Total miscellaneous shipments	710
Total shipments	878
Total shipments last year.....	1, 015
Decrease from last year.....	137
Respectfully submitted.	

W. C. WINLOCK,
Curator of Exchanges.

Mr. S. P. LANGLEY,
Secretary of the Smithsonian Institution.

APPENDIX IV.

REPORT OF THE ACTING MANAGER OF THE NATIONAL ZOOLOGICAL PARK FOR THE YEAR ENDING JUNE 30, 1893.

SIR: I have the honor to submit the following report of the operations of the National Zoological Park for the fiscal year ending June 30, 1893.

By act of Congress dated August 5, 1892, the sum of \$50,000 was appropriated to maintain and improve the park. As no provision was made by this act for the purchase of animals, calculations were made as to the cost of maintaining the collection already on hand and plans for further improvement were based upon the balance then available. The buffalo, elk, and other native wild animals have naturally received the most attention. Effort has been made to place them as far as possible in natural conditions by extending the paddocks assigned to them. While it has not been practicable to give them large ranges, many acres in extent, as was at first intended, since it is now found desirable that they be kept where they can be readily viewed by the public, yet the inclosures are of considerable size. The accompanying engraving represents a group of buffalo now in the Park.

In the preceding year it was necessary to place in the large animal house the animals requiring heat, although that house was still in an unfinished state. During the present year it has been completed, except the outer cages, and a tile roof has been substituted for the temporary one. The plans for the house contemplated additions to the main structure, and as more room was urgently needed and the available funds were insufficient for a stone addition, a frame extension has been built conforming to the original plan in size and form. A row of permanent cages occupies either side of this extension and a large tank in the middle of the room accommodates aquatic animals. By this means it has been possible to give the animals comfortable and suitable quarters where they can be easily seen by the public. It is, however, a matter of great regret that the entire structure was not built of stone and nothing but pressing necessity can excuse the erection of the present extension.

On the meadow upon the right bank of the creek paddocks have been inclosed and a small thatched barn built to shelter a small herd of llamas. These animals were purchased last year in South America through the kindness of Col. W. P. Tisdell, of the Bureau of American Republics.

The plan submitted by the landscape architects provided for a large pond for waterfowl and other aquatic animals at the bend of the creek below the bridge. This pond has been excavated, but fencing and shelters are needed before animals can be put in it.

The principal road through the park was last year completed only to the hill in front of the buffalo house. From this point to the park limit, near Connecticut Avenue Extended, an old wood road had been used, but it was of too steep a grade. A new road has therefore been projected and begun. This road will wind around the spurs of the hill sloping downward toward Rock Creek, bringing to view some of the most beautiful natural scenery of the park, and as it will lead by easy and gradual ascent toward the roads that connect the western entrance with the Woodley road it can not fail to be a favorite and much frequented drive.

There is great need of some easier access to the park than now exists. From the



GROUP OF BUFFALO.
National Zoological Park.

Rock Creek Railway at either end of the park to the animal house is half a mile, and from the Fourteenth street car line a still greater distance. This is a serious inconvenience to many people, particularly the aged and infirm, who have only this means of reaching the park. For carriages the Quarry road is far too narrow and very steep, the grade being 9 per cent in some places.

During the year the District authorities improved this road considerably, properly grading and guttering it and building a suitable sidewalk. While this is a great improvement, the grade of the road is such that it can never be suitable for a principal avenue of access. It is possible that when the projected improvement of Kenesaw avenue is completed that some amelioration of this condition may ensue. There seems to be no reason why street cars should not find ready access to the park by this route.

The unexpected number of visitors made it essential to increase the capacity of the bridge and to protect foot passengers who use it. Footways have accordingly been added to the original structure. These are not wide enough to properly accommodate the public, but are as wide as is consistent with the safety of the structure.

The offices of the park remain in the dilapidated house known as the Holt mansion. When the park was first projected it was expected that the superintendent would reside on the premises, and this building seemed to offer a suitable residence. The experience of the last two years has shown that that plan was a wise one. There should undoubtedly be some one always at hand in the park to respond to any calls that may be made in an emergency. Besides this the park is never closed to the public, and it is therefore desirable that the Superintendent should be always accessible. During the past year several valuable deer have been attacked by dogs during the night and either worried to death or injured so that they had to be killed.

A list of the animals now in the park is herewith submitted, together with statements of those that have been received from various sources. A few animals have been presented, among the most notable being two fine wolf-hounds from Southern Russia by Mr. Byron G. Daniels, U. S. consul at Hull, England; an alligator over 10 feet in length by Mr. E. S. Schmidt, of this city, and a black wolf by Mr. R. M. Middleton, jr., of South Pittsburg, Tenn. These gifts are properly appreciated, yet it is found that increases from such sources can not be depended on to keep up the collection.

From the Yellowstone National Park 17 animals were received. These were kept at that park for some time before shipment, and were then transported by freight, in charge of a keeper. Unless animals can be obtained in greater numbers it will be found that this is a very expensive and precarious method of obtaining them.

A few animals have been loaned, notably a tiger, by Mr. J. T. McCaddon, manager of the Adam Forepaugh shows, and a zebu by Mr. A. E. Randle, of this city. These are subject to recall by their owners. Although such animals do not become the property of the park, yet an opportunity is afforded of exhibiting them for a considerable time for the mere expense of their care and feeding.

The provisions of the appropriation were such that no animals could be purchased during the year, and a number of fine opportunities for acquiring specimens was thus lost.

A few animals were born in the park, among which were a bison, a deer, two elk, and a llama.

The losses by death have been considerable, amounting to as much as 20 per cent of the entire collection.

The total number of animals now on hand is 504, being an increase of 56 over the number on hand at the first of the year.

Animals in the collection June 30, 1893.

Name.	No.	Name.	No.
American bison (<i>Bison americanus</i>)	8	American civet-cat (<i>Bassarist astuta</i>)	1
Zebu (<i>Bos indicus</i>)	2	Raccoon (<i>Procyon lotor</i>)	9
Common goat (<i>Capra hircus</i>)	3	American badger (<i>Taxidea americana</i>)	5
Angora goat (<i>Capra hircus angorensis</i>)	1	Black bear (<i>Ursus americanus</i>)	4
Llama (<i>Auchenia glama</i>)	7	Cinnamon bear (<i>Ursus americanus</i>)	3
American elk (<i>Cervus canadensis</i>)	9	Grizzly bear (<i>Ursus horribilis</i>)	1
Virginia deer (<i>Cervus virginianus</i>)	8	Polar bear (<i>Thalassarcos maritimus</i>)	2
Mule deer (<i>Cervus macrotis</i>)	2	Opossum (<i>Didelphys virginiana</i>)	5
Peccary (<i>Dicotyles tajacu</i>)	7	Bald eagle (<i>Haliaeetus leucocephalus</i>)	1
Indian elephant (<i>Elephas indicus</i>)	2	Sparrow hawk (<i>Falco sparverius</i>)	1
"Himalayan" rabbit (<i>Lepus cuniculus</i>)	1	Red-tailed hawk (<i>Buteo borealis</i>)	3
Musk rat (<i>Fiber zibethicus</i>)	7	Marsh hawk (<i>Circus hudsonius</i>)	1
Coyote (<i>Canis latrans</i>)	1	Snowy owl (<i>Nyctea nivea</i>)	1
Beaver (<i>Castor canadensis</i>)	1	Great horned owl (<i>Bubo virginianus</i>)	5
Prairie dog (<i>Cynomys ludovicianus</i>)	100	Barred owl (<i>Syrnium nebulosum</i>)	1
Striped ground-squirrel (<i>Spermophilus tridecemlineatus</i>)	8	Barn owl (<i>Strix pratineola</i>)	2
Chipmunk (<i>Tamias striatus</i>)	2	Screech owl (<i>Megascops asio</i>)	2
Gray squirrel (<i>Sciurus carolinensis</i>)	2	Yellow and blue macaw (<i>Ara ararauna</i>)	1
Albino gray squirrel (<i>Sciurus carolinensis</i>)	1	Red and blue macaw (<i>Ara chloroptera</i>)	2
Red squirrel (<i>Sciurus hudsonius</i>)	1	Red and yellow and blue macaw (<i>Ara macao</i>)	1
Crested porcupine (<i>Hystrix cristata</i>)	4	Sulphur-crested cockatoo (<i>Cacatua galerita</i>)	1
Canada porcupine (<i>Erethizon dorsatus</i>)	2	Green parrot (<i>Chrysotis</i> sp.)	6
Capybara (<i>Hydrochoreus capybara</i>)	1	Mocking bird (<i>Mimus polyglottus</i>)	2
Paca (<i>Cologenys paca</i>)	2	Common crow (<i>Corvus americanus</i>)	7
Agouti (<i>Dasyprocta aguti</i>)	3	Clarke's nutcracker (<i>Picicorvus columbianus</i>)	2
Acouchy (<i>Dasyprocta acouchy</i>)	3	Domestic fowl (<i>Gallus domesticus</i>) varieties..	10
Diana monkey (<i>Cercopithecus diana</i>)	1	Curassow (<i>Craz alector</i>)	5
Givet monkey (<i>Chlorocebus enyathithea</i>)	1	Pea fowl (<i>Pavo cristatus</i>)	10
Patas monkey (<i>Chlorocebus ruber</i>)	1	Guinea fowl (<i>Numida meleagris</i>)	1
Kra monkey (<i>Macacus cynomolgus</i>)	1	Bob white (<i>Colinus virginianus</i>)	1
Macaque monkey (<i>Macacus</i> sp.)	1	European quail (<i>Coturnix communis</i>)	4
Apella monkey (<i>Cebus apella</i>)	1	California quail (<i>Callipepla californica</i>)	1
Monk ceebus (<i>Cebus xanthocephalus</i>)	1	Cariama (<i>Cariama cristata</i>)	1
Black-faced coaita (<i>Ateles ater</i>)	1	Sand-hill crane (<i>Grus canadensis</i>)	2
Spider monkey (<i>Ateles griseus</i>)	1	Black-crowned night heron (<i>Nycticorax nycticorax</i>)	1
Douroucouli (<i>Nyctipithecus trivirgatus</i>)	3	Scarlet ibis (<i>Iguara rubra</i>)	1
Pinche monkey (<i>Midas edipus</i>)	1	Canada goose (<i>Branta canadensis</i>)	4
European hedgehog (<i>Erinaceus europæus</i>)	1	Swan (<i>Cygnus gibbus</i>)	4
Lion (<i>Felis leo</i>)	1	Black swan (<i>Chenopsis atrata</i>)	2
Tiger (<i>Felis tigris</i>)	1	Chinese goose (<i>Anser</i> sp.)	4
Puma (<i>Felis concolor</i>)	1	Herring gull (<i>Larus argentatus</i>)	1
Ocelot (<i>Felis pardalis</i>)	2	Gannet (<i>Sula bassana</i>)	2
Wild cat (<i>Lynx rufus maculatus</i>)	1	Alligator (<i>Alligator mississippiensis</i>)	13
Russian wolf-hound (<i>Canis familiaris</i>)	8	Snapping turtle (<i>Chelydra serpentina</i>)	2
Black wolf (<i>Canis occidentalis</i>)	2	Florida gopher (<i>Testudo carolina</i>)	1
Coyote (<i>Canis latrans</i>)	2	Mud turtle (<i>Chrysemys</i> sp.)	3
Red fox (<i>Vulpes fulvus</i>)	7	"Gila monster" (<i>Heloderma suspectum</i>)	2
Swift fox (<i>Vulpes velox</i>)	6	"Chuck molly" (<i>Sauromalus ater</i>)	1
Gray fox (<i>Vulpes virginianus</i>)	6	Horned toad (<i>Phrynosoma douglassii</i>)	1
Mink (<i>Putorius risson</i>)	2	Tiger rattlesnake (<i>Crotalus tigris</i>)	1
Ferret (<i>Putorius furo</i>)	10	Diamond rattlesnake (<i>Crotalus adamanteus</i>)	3
Kinkajou (<i>Cerculeptes caudivolutus</i>)	1	Confluent rattlesnake (<i>Crotalus confluentis</i>)	2
Gray coatimundi (<i>Nasua narica</i>)	1	Ground rattlesnake (<i>Caudisona miliaris</i>)	1
Red coatimundi (<i>Nasua rufa</i>)	1	Water moccasin (<i>Ancistrodon piscivorus</i>)	1

Animals in the collection June 30, 1893—Continued.

Name.	No.	Name.	No.
Copperhead (<i>Ancistrodon contortrix</i>).....	1	Hog-nosed snake (<i>Heterodon platyrhinus</i>)...	4
Boa (<i>Boa constrictor</i>).....	2	South American frogs and toads (unidentified)	14
Anaconda (<i>Eunectes murinus</i>).....	1	SUMMARY.	
King snake (<i>Ophibolus getulus</i>).....	2	Indigenous animals.....	322
Pine snake (<i>Pityophis sayi</i>).....	1	Foreign animals, not domesticated.....	87
Black snake (<i>Bascanion constrictor</i>)...	2	Foreign animals, usually domesticated.....	95
Garter snake (<i>Eutaenia sirtalis</i>).....	2	Total.....	504
Water snake (<i>Tropidonotus sipedon</i>).....	10		

List of accessions.

ANIMALS PRESENTED.

Name.	Donor.	Num- ber of speci- mens.
Marmoset.....	C. O. Chenault, New Orleans, La.....	1
Black wolf.....	R. M. Middleton, jr., South Pittsburg, Tenn.....	1
Gray fox.....	Dr. T. M. Hyneman, Norfolk, Va.....	1
Do.....	F. F. Cooper, Staffords Store, Va.....	1
Do.....	J. R. Williams, Washington, D. C.....	1
Do.....	Jos. Schultz and F. J. Simonds, Washington, D. C.....	1
Coati-mundi.....	C. O. Chenault, New Orleans, La.....	1
Mink.....	Superintendent Rock Creek Rwy., Washington, D. C.....	2
Black bear.....	Lee Kerr and Eugene Pence, Columbia Falls, Mont.....	1
Do.....	W. H. McClain, Greenville, Miss.....	1
Raccoon.....	R. B. Saunders, Washington, D. C.....	1
Do.....	.....	1
Russian wolf-hounds.....	Hon. B. G. Daniels, U. S. consul at Hull, England.....	2
Goat.....	F. M. Thornett, Anacostia, D. C.....	1
Guinea pig.....	Otto Haltenorth, Washington, D. C.....	4
Rabbit.....	R. B. Clarke, Washington, D. C.....	2
Himalayan rabbit.....	H. Burner, Washington, D. C.....	2
Gray squirrel.....	F. C. Weaver, Washington, D. C.....	1
Opossum.....	J. D. Morey, Washington, D. C.....	1
Sparrow hawk.....	W. D. Appich, Alexandria, Va.....	1
Do.....	F. L. Thomas, Ashton, Md.....	1
Red-tailed hawk.....	G. C. Nichols, Cazenovia, N. Y.....	1
Marsh hawk.....	P. W. Skinner, Washington, D. C.....	1
Snowy owl.....	Frank Bolles, Chocorua Falls, N. H.....	1
Great horned owl.....	do.....	2
Do.....	Camm Brothers, Lynchburg, Va.....	1
Do.....	J. U. French, Bristersburg, Va.....	1
Do.....	Mrs. Carpenter, Washington, D. C.....	2
Barn owl.....	Miss J. B. Gray, Fredericksburg, Va.....	1
Golden-winged wood- pecker.....	M. E. C. Sproesser, Washington D. C.....	1
Kingfisher.....	Alice Buckney and Susie Mathews, Washington, D. C.....	1
Mocking-bird.....	C. E. Ingersoll, U. S. Fish Commission.....	1
Common crow.....	J. F. Edwards, Washington, D. C.....	1
European quail.....	Mr. Loeffler, Washington, D. C.....	4
Virginia quail.....	B. T. Rhodes, Washington, D. C.....	1
Pea fowl.....	Hon. Benjamin Harrison, Washington, D. C.....	1

List of accessions—Continued.

ANIMALS PRESENTED—Continued.

Name.	Donor.	Number of specimens.
Coot	J. Q. Larmer, Washington, D. C.	1
Long-tailed duck	George Schaffer, Alexandria, Va.	1
Canada goose	W. H. Green, Washington, D. C.	2
Gannet	Taylor Brothers, Washington, D. C.	2
Alligator	E. W. Tanner, Washington, D. C.	2
Do.	J. A. Baker, Washington, D. C.	1
Do.	E. S. Schmid, Washington, D. C.	1
Do.	R. P. Carlton, Washington, D. C.	3
Florida gopher.	D. C. Harrison, U. S. Geological Survey.	1
Gila monster.	Dr. M. M. Crocker, Gila Bend, Ariz.	1
Horned toad	Miss Davis, Washington, D. C.	2
Glass snake.	Capt. Henry Romeyn, Mount Vernon Barracks, Ala.	1
Rattlesnake	W. A. Shoup and J. L. Spear, Spear, Okla.	1
Black snake	Harry Salais, Washington, D. C.	1
Do.	F. S. Watrous, Washington, D. C.	2
Hog-nosed snake	J. E. Blascott, Washington, D. C.	1
Garter snake	F. C. Watrous, Washington, D. C.	2
Water snake.	do.	3
Do.	U. S. Fish Commission	10
		86

ANIMALS RECEIVED IN EXCHANGE.

Name.	Received from.	Number of specimens.
Macaque monkey.	E. S. Schmid, Washington, D. C.	1
Durukuli monkey	do.	2
Black-faced coaita	do.	1

Animals born in the National Zoological Park.

American bison (<i>Bison americanus</i>)	1
Virginia deer (<i>Cariacus virginianus</i>)	1
American elk (<i>Cervus canadensis</i>)	2
Russian wolf hounds (<i>Canis familiaris</i>)	6
Red fox (<i>Vulpes fulvus</i>)	6
Swift or kit fox (<i>Vulpes velox</i>)	4
Llama (<i>Auchenia glama</i>)	1
Peccary (<i>Dicotyles tajacu</i>)	5
Crested porcupine (<i>Hystrix cristata</i>)	1
Opossum (<i>Didelphys virginiana</i>)	6

Animals captured in the National Zoological Park.

Opossum (<i>Didelphys virginiana</i>)	2
Hog-nosed snake (<i>Heterodon platyrhinus</i>)	1
Water snake (<i>Tropidonotus sipedon</i>)	1

*Animals obtained by purchase.**

Llama (<i>Auchenia glama</i>), through Col. W. P. Tisdell, of the Bureau of American Republics	8
--------------------------------------------------------------------------------------------------------	---

List of animals received from the Yellowstone National Park.

Red fox (<i>Vulpes fulvus</i>)	2
Cinnamon bear (<i>Ursus americanus</i>)	2
Black bear (<i>Ursus americanus</i>)	3
Badger (<i>Taxidea americana</i>)	1
Mule deer (<i>Cariacus macrotis</i>)	1
American elk (<i>Cervus canadensis</i>)	4
Beaver (<i>Castor canadensis</i>)	1
Porcupine (<i>Erethizon dorsatus</i>)	1

SUMMARY OF ACCESSIONS.

Animals presented	86
Animals loaned	54
Animals received in exchange	4
Animals purchased	8
Animals born in the Zoological Park	80
Animals captured in the Zoological Park	4
Animals received from Yellowstone National Park	15
<hr/>	
Total accessions	251
Number of animals on hand June 30, 1892	448
Accessions during the year ending June 30, 1893	251
<hr/>	
Total	699

Deduct.

Deaths	119
Animals exchanged	47
Animals returned to owners	29
<hr/>	
	195
<hr/>	
Animals on hand June 30, 1893	504
Respectfully submitted.	

FRANK BAKER,
Acting Manager.

* These animals were actually purchased during the fiscal year 1891-'92, but did not arrive at the Park until after the beginning of the next fiscal year.

APPENDIX V.

ASTRO-PHYSICAL OBSERVATORY.

At present the astro-physical observatory is under the immediate direction of the Secretary, but owing to the pressure of other occupations the conduct of the work in detail has lain largely in the hands of Mr. F. L. O. Wadsworth, who received the appointment of senior assistant on October 10, and to whose efficient aid the Secretary is pleased to acknowledge his obligation.

The general work of the observatory for the year has pertained to the investigation of the infra-red portion of the spectrum, briefly referred to last year, and described in general in the body of my report. It may conveniently be classified under three general heads:

A. General spectro-bolographic work.

B. Special spectro-bolographic work.

C. Instrumental work, including manufacture of new apparatus and the perfection of old.

A. The general bolographic work of the year, (which can be carried on only when the sky is unobscured by clouds or haze), is summed up as follows:

A "Bolograph" is an *automatic* reproduction of the energy curve, made by the new process.

	Days available for bolo- metric work.	Number of bolo- graphs taken.	Character of bolographs.	Remarks.
1892.				
July	10	7	.....	Time mostly occupied by work on wave-length apparatus.
August	1	1	Taken with glass prism.....	Observatory closed fifteen days.
September	4	10	do	Do.
October	8	.....	.....	Observatory closed ten days.
November	8	23	Glass prism	
December	6	22	do	
1893.				
January	4	.....	.....	Time occupied with grating work.
February	4	8	Grating	Do.
March	13	24	Glass and rock salt	
April	6	14	do	
May	14	40	do	
June	5	27	Rock-salt prism	

SUMMARY:

Total number of days available (<i>i. e.</i> , of sunshine days) for bolometric work.....	83
Total number of bolographs taken:	
(1) With glass prism	114
(2) With rock-salt prism	54
(3) With grating	8
Total	176

Complete records of all of these bolographic curves have been kept in the book specially provided for that purpose, and from them by another automatic process are produced the linear spectra of which an illustration follows. As elsewhere stated, the result of the year's work has been the discovery and approximate determination of position of about 150 or 200 new lines in this hitherto almost unexplored region.

The accompanying illustration of one of the "rock-salt" spectra of the *invisible* spectrum obtained by the new process is intended to give a general, if crude, idea of the novelty, the extent, and (it may be hoped) the value, of this field of labor.

The visible solar spectrum, first investigated by Sir Isaac Newton, is represented as to its length by the blank space on the left; the number .4 (*i. e.*, the part where wave-length is four-tenths of a micron) and .8 (*i. e.*, the part where wave-length is eighth-tenths of a micron) representing the extremities of the solar spectrum as known to him.

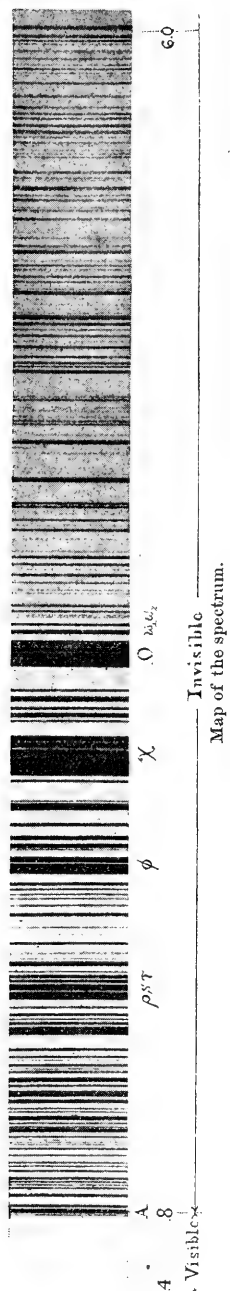
Below this all is invisible, and the investigations made at this Observatory by the novel bolometric methods here referred to have been chiefly instrumental in carrying the mapping of lines to 6.0 (six micron), or through nearly thirteen times the extent known to Newton. The great majority of all the lines which fill this space have been discovered and laid down by the new bolometric method, and most of them here in Washington during the last two years.

B. The special bolographic work, which is carried on during the cloudy weather, during which the regular work is necessarily interrupted, includes the classification, detailed examination, and, finally, the reduction of the bolographs taken to linear representatives of the infra-red spectrum, in which the final result is a line photograph which is precisely similar, as far as automatic reduction processes will admit, to the line spectrum photographs of the visible part of the spectrum. Owing to the labor involved in this reduction it has been deemed desirable to apply this process of reduction only to the best of the bolographs taken. The result of this portion of the work is briefly summed up as follows:

Line spectrum photographs.

Bolographs reduced for the month of—	Number.	Character of bolograph.	Region represented.
1892.			
July			
August			
September			
October			
November	7	Taken with glass prism	Infra-red spectrum down to wave length $\lambda = 2.5 \mu$.
December	11	.....do	Do.
1893.			
January			
February			Infra-red spectrum down to wave length $\lambda = 2.5 \mu$.
March	10	Taken with glass prism	Do.
April	3	Taken with rock salt prism	Infra-red spectrum down to wave length $\lambda = 5 \mu$.
May	3	.....do	Do.
June	5	.....do	Do.
Total from glass prism			28
Total from rock salt prism			11
Aggregate			39

These represent complete line spectrum charts of the invisible portion of the spectrum down to about 2.5μ for the glass and 5μ for the rock salt prism.



While this number seems small in comparison with the whole number of bolographs taken, it nevertheless represents even more work. In this particular work the history of the year is one of continual change and improvement and many of the bolographs of the earlier part of the year have been reduced by three different processes, each of which involves three distinct photographic steps, and in consequence the 39 final line spectrum photographs stand for more than 200 finished photographs, and as many more which are experimental.

After a large amount of experimental work, a process has finally been perfected which is fairly satisfactory, and has been adopted provisionally as a working method. Experiments, however, are still in progress with a view to further modification and improvement.

In addition to this bolometric work proper, experiments on three special methods of investigation of the infra-red spectrum, have formed a considerable portion of the year's work:

(1) Preliminary experiments on the measurement of wave-lengths in the invisible spectrum by interference methods.

(2) Experiments on photographing the invisible spectrum by the aid of phosphorescent films.

(3) Preliminary experiments on bolometric investigation of the infra-red normal (grating) spectrum.

I. During the month of July, 1892, a series of preliminary experiments was made on a method of measurement of wave-lengths in the invisible spectrum, with special reference to the establishment of a few datum points with great accuracy. The apparatus employed for this purpose, which was kindly lent by Clark University, was a modification of the inferential wave comparer used with so much success by Prof. Michelson, in the establishment of a wave-length standard.

As the method of working was entirely new, considerable time was required to put the apparatus in working order. Some preliminary results were obtained in the region just above "A," by Mr. Wadsworth, in whose hands I placed it, but the work was interrupted by his departure for Paris, and has not since been resumed. The accuracy and practicability of this method of determining wave-lengths has, however, been demonstrated, and it is hoped time will be found in the near future to continue this work.

II. During the month of October I made a number of experiments to determine the practicability of photographing the infra-red spectrum directly with the aid of phosphorescent films.

After considerable experimentation on the best method of working, a number of photographs of the invisible portion of the spectrum extending as far as wave-length 1.5μ were thus obtained. Although the detail is very much less than that obtained by the bolometer, the method is valuable in furnishing a general check on the results of the more analytical method. With greater care in the preparation of films, still better results could be obtained. Other films sensitive to heat rays were tried, particularly those containing a salt of mercury, but without adequate results.

III. During the winter months of January and February, in which regular bolometric work was almost entirely interrupted by bad weather, attention was devoted to the theoretical investigation of a method of bolometrically investigating the normal grating spectrum, the essential feature of which was the employment of a "lifting" prism, by the use of which the superposed spectra were to be avoided.

After determination of the best instrumental conditions, provisional apparatus was constructed and installed, and a few experimental bolographs taken. The approach of good observing weather then necessitated its removal. A paper describing the method and containing the essential results of the investigation of the instrumental conditions has been prepared for publication.

C. What might almost be said to have been the chief work of the Observatory for the year has been the improvement of the apparatus and instrumental conditions of working.

The lines of development have been: (1) In the increase of delicacy; (2) in the increase of stability and accuracy.

With a view to increased delicacy much time has been devoted through the year to the improvement of the galvanometer.

During the absence in Europe of the present senior assistant, he, by my direction, devoted two weeks exclusively to this work, and the elements of three galvanometers were constructed after his design, two by Nalder Bros. and one by Elliott Bros. After his return, the work of improvement of my earlier designs for the old galvanometer and of the new ones was at once begun. Pending the completion of the new galvanometers, the improvement of the three old ones already in use was undertaken, and the delicacy of each was more than doubled. Up to date only one of the new galvanometers has been completed, and this owing to the introduction of an almost unprecedentedly light, magnetic system, and through other improvements, has been found to be about 35 times more delicate than the best of these previously in use.

This degree of delicacy will, it is probable, be exceeded by one of the two remaining forms, but lack of time has prevented further improvement at present. Indeed the conditions of use at present are such as to render only about one-tenth of this increased delicacy available, and only a new laboratory will enable the full increase of delicacy to be perfectly utilized.

An abbreviated statement of the galvanometer work for the year is appended:

Galvanometer.	Description.	Old constant.*	New constant (after improvement).
(Old).....	D'Arsonval.....	0.00000010000	.00000002000
White (old) Alleghany pattern.....	Thomson.....	0.00000000150	.00000000070
Queen (old).....	do.....	0.00000000160	.00000000040
Elliott Bros. special design new.....	do.....		.00000000004
Nalder Bros. special design new.....	Thomson (multiple)†.....		.00000000002
Do.....	D'Arsonval.....		Not finished.

* Current which deflects image one millimetre at distance of 1 metre, when the time of a single vibration is 10 seconds.

† Partially finished.

For use in these new galvanometers, the laboratory has received during the year, a lot of very fine quartz fibers, made to special order by Prof. C. C. Hutchins, and some very small, light, and accurate concave mirrors from J. A. Brashear, the use of which in the new galvanometer has been already referred to. A very considerable improvement in the mechanical steadiness of this part of the apparatus has also been effected by mounting the whole galvanometer in a massive metal case, which rests on a series of stone blocks placed one above another and separated from each other by sheets of rubber. In spite of these precautions, the vibrations due to passing teams and wagons are at times still very troublesome.

(2) The improvement in the other parts of the apparatus has been mainly in the direction of increased accuracy. The siderostat has been provided with a new electric control, by means of which inaccuracies of running may be quickly compensated for from inside the building. Considerable improvement has also been effected in the minor parts of the instrument, but it still needs to be thoroughly overhauled. The changes for which there is most pressing need are the remounting of the equatorial axis on ball bearings and the construction of a new governor for the clock.

The spectro-bolometer and its accessories is that part of the train of apparatus which has undergone the most radical change. The principal changes which have been made in its construction and working during the past year are:

(1) The adoption of a reflecting mirror secured to the prism and revolving with it, which has rendered it possible to fix both the spectro-bolometer slit and the bolometer itself in position, thereby avoiding the use of a long revolving arm.

This device permits of indefinite extension of the bolometer arm, and consequently the reduction of the angular value of the bolometer strip to a very minute quantity.

(2) The provision of a new adjustable tangent arm for slowly rotating the axis of the spectro-bolometer with great accuracy.

(3) The adoption of a new system of clock-work for synchronously driving this tangent arm, and the photographic plate on which the galvanometer record is taken, in place of the two independent driving clocks before used.

(4) The mounting of all parts of the spectro-bolometer on rigid iron or stone supports.

The improvements in the method of working which have accompanied these improvements in apparatus are:

(1) The substitution of glass plates for flexible films for the photographic records. The irregular errors due to shrinkage of the film have thus been eliminated and the subsequent photographic processes rendered much easier by reason of the greater facility of handling.

(2) The reduction, and in some cases almost entire elimination, of the "drift" by the use of a water-jacket about the fixed bolometer case, together with careful attention to all the electrical details of the bolometer and galvanometer connections, and the substitution of storage battery cells for the Daniel cells, formerly used to supply the current to the bridge circuit. The "drift," however, still remains a source of great trouble and I expect to secure its elimination only (if at all) by the establishment of uniform temperature conditions, which it is impossible to obtain in the present laboratory (at least during the summer months).

The laboratory building itself has been considerably improved during the past year. A small annex, which is used as a photographic dark room, was erected in the spring of 1893, and has greatly facilitated the photographic work of the observatory. During the summer a small air-cooling plant was placed in the basement, and served not only to increase the comfort of the observers, but also to secure more favorable conditions for the work then being carried on with rock salt.

During the past year the observatory also fitted up a small instrument shop for the construction and repair of its apparatus, comprising an instrument-maker's lathe, built to my special order, a small planer from the Hendley Machine Company, and a fairly complete stock of small tools, and stock material. A dynamo, for supplying current to the observatory for charging the storage batteries and to the shop for power purposes, was also purchased and temporarily placed in the National Museum. Owing to the lack of suitable quarters the shop has not yet been permanently located, but occupies a temporary shed south of the Smithsonian building.

The important pieces of apparatus acquired during the year may be divided into two general classes: (1) Physical apparatus of precision; (2) accessory apparatus.

I. To the former class belongs:

- (1) Three new galvanometers and sets of galvanometer coils from Elliott Brothers and Nalder Brothers.
- (2) Resistance boxes one of 100,000 ohms and one of 1,000 ohms from Nalder Brothers.
- (3) A set of fine quartz fibers, from Prof. C. C. Hutchins.
- (4) Six fine galvanometer mirrors, from J. A. Brashear.
- (5) One large glass prism, from J. A. Brashear.
- (6) Two large glass lenses, from J. A. Brashear.
- (7) Two new large rock salt lenses, from M. E. Kahler.
- (8) A collection of valuable rock salt crystals, from Germany.
- (9) Three new $\frac{1}{4}$ -milometer bolometers, from Grunow.
- (10) One large 24-inch camera, a fine Ross lens, and a complete photographic outfit, from Scoville & Co.
- (11) A new tangent arm for spectro-bolometer, from J. A. Brashear.

(12) A new prism holder, with large glass flat, from J. A. Brashear.

II. Accessory apparatus:

- (1) A complete instrument-maker's lathe, with outfit of tools and chucks.
- (2) A 30-inch hand and power planer for metal work, with chuck, etc., from the Hendley Machine Company.
- (3) A 40-light incandescent dynamo, with rheostats, etc., from Westinghouse Electric Company.
- (4) A one-half horse power motor, from Akron Electric Company.
- (5) A one-fourth horse-power water motor and Sturtevant pressure fan, with accessory apparatus for cooling the air of the Observatory.

The total value of the apparatus purchased during the year was about \$3,000.

MINOR WORK OF THE YEAR.

In addition to Mr. Wadsworth's work with Prof. Michelson in the establishment of the length of the standard meter in terms of the wave length of light, at the International Bureau of Weights and Measures, reference to which has already been made, the following special work, which has been done during the year, may be mentioned:

(1) The preparation of a complete series of line-shaded drawings of the principal pieces of apparatus in the observatory on a scale requisite to show their detailed construction.

(2) The preparation of a series of enlargements of moon photographs from the Kenwood and Lick observatories, photographs.

(3) Experiments in temperature and radiation work.

During the latter part of the year preliminary experiments were begun and carried on at intervals looking to the systematic preparation for another extended research, which I have proposed to soon begin to determine the physical relation between temperature and radiation. The experiments have mostly been directed to the establishment of a satisfactory source of temperature and means of measuring the same. The various apparatus, etc., for the prosecution of this work at an early date has either been ordered or already installed.

(4) Some further attempts have been made at solar photography, but, as the experience of last year conclusively showed, the atmospheric conditions here in the city are very unfavorable to any satisfactory work in this direction.

PERSONNEL.

The force of the Observatory consists of a Senior assistant, and an instrument-maker, and an assistant instrument-maker. During the past year the Observatory has also had at different times special assistants, among whom I wish to acknowledge the assistance of Mr. J. G. Hubbard, to whose photographic skill several improvements of this part of the work are due.

APPENDIX VI.

REPORT OF THE LIBRARIAN FOR THE YEAR ENDING JUNE 30, 1893.

SIR: I have the honor to submit herewith a report upon the operations of the library of the Smithsonian Institution during the fiscal year ending June 30, 1893.

The work of recording accessions has been conducted as in the preceding years. The entry numbers in the accession book extend from 246, 110 to 268, 386.

The following table shows the number of volumes, parts of volumes, pamphlets, and charts received during the year:

Publications received between July 1, 1892, and June 30, 1893.

	Quarto or larger.	Octavo or smaller.	Total.
Volumes	594	1, 245	1, 839
Parts of volumes	16, 650	6, 299	22, 949
Pamphlets	870	3, 581	4, 451
Charts			249
Total			29, 488

Of these publications, 272 volumes, 6,981 parts of volumes, and 821 pamphlets, 8,074 in all, were retained for use in the U. S. National Museum.

Nine hundred and sixty-three medical dissertations were deposited in the library of the Surgeon-General U. S. Army; the remaining publications were sent to the Library of Congress on the Monday after their receipt.

In carrying out the plan formulated by the Secretary for increasing the library by exchanges, 781 letters asking for publications not on our list, or asking for numbers to complete the series already in the library, have been written. It gives me pleasure to report that as a result of this correspondence 246 new exchanges were acquired by the Institution, while 81 defective series were completed, either wholly or as far as the publishers were able to supply missing parts.

Since this plan of the Secretary was first formulated in 1887, 4,512 letters have been written with a view of increasing the number of periodicals and transactions of learned societies in the library of the Smithsonian Institution. The result of this work has been most gratifying; 1,350 new periodicals have been added to the list and 909 defective series have been either completed or filled out as far as the publishers were able to supply missing parts.

The reading room is now taxed to its utmost capacity; the 494 boxes for the use of scientific periodical literature are all filled and periodicals which it would be desirable to keep in the general reading room must be placed elsewhere for lack of space. The reading room no longer has sufficient accommodations for the growing exchanges of the Institution nor for the persons desiring to consult this important collection of current scientific literature.

Ever since 1890 the Secretary has called attention in his annual report to the fact that the present quarters of the library are insufficient; the natural expansion of the library has been prevented by the fact that the rooms adjacent to the library were occupied by the bureau of international exchanges. It will be possible shortly to assign other quarters to the bureau of international exchanges, and plans have been prepared for book shelves in one of the rooms made vacant. It is estimated that space will thus be secured for about 6,000 volumes.

In addition to the strictly scientific literature which is contained in the reading

room, the literary magazines are also on file and their use by the officers and employés of the Institution and the National Museum is constantly increasing.

Below is a comparative statement of the operations of the library since June 30, 1890:

Number of publications received.

	1890-'91.	1891-'92.	1892-'93.
Volumes.....	2,681	1,989	1,839
Parts of volumes.....	20,525	23,729	22,949
Pamphlets.....	3,769	3,589	4,449
Charts.....	319	621	249
Total.....	27,294	29,928	29,486

It will be observed that this comparative table shows a slight decrease in the number of publications received during the current year over the preceding year. The decrease, however, is in volumes, and is due to the fact that the limit of the possibility of completing series of publications by exchange, seems to have been reached.

The number of titles for the past year shows an increase of almost 2,000 over that of the year preceding.

The following table shows the number of titles received per year for the past six years:

Number of titles received.

1887-'88.....	12,105
1888-'89.....	11,370
1889-'90.....	13,474
1890-'91.....	18,409
1891-'92.....	20,523
1892-'93.....	22,276

It will be seen from the above table that the number of titles received by the library has almost doubled since 1887, a gratifying fact, yet one which severely taxes the library force in the recording and arrangement of the material received.

No fewer than 4,087 acknowledgments of publications were made by the post card and other printed forms, while many gifts were acknowledged by special letter.

The following universities have sent complete sets of their academic publications, including inaugural dissertations:

Basel,	Greifswald,	Louvain.
Berlin,	Halle, A. S.,	Lund,
Bern,	Heidelberg,	Marburg.
Bonn,	Helsingfors,	Strasburg,
Breslau,	Jena,	Tübingen.
Dorpat,	Johns Hopkins.	Utrecht.
Erlangen,	Kiel,	Wurzburg,
Freiburg, Br.,	Königsberg,	Zurich.
Giessen,	Leipzig.	

On July 1, 1892, Mr. J. Elfreth Watkins was appointed Assistant in charge of the library, a position which he held until the first of October. From that date until December 1, Mr. N. P. Scudder was acting Librarian.

Very respectfully, yours,

CYRUS ADLER,
Librarian.

Mr. S. P. LANGLEY,
Secretary of the Smithsonian Institution.

APPENDIX VII.

REPORT OF THE EDITOR FOR THE YEAR ENDING JUNE 30, 1893.

SIR: I have the honor to submit the following report upon the publications of the Smithsonian Institution for the year ending June 30, 1893:

I. SMITHSONIAN CONTRIBUTION TO KNOWLEDGE.

Of the Volume XXVII of the quarto series of "Contributions" (having the serial No. 839 in the Smithsonian list of publications) only a part has yet been issued, namely, No. 801, "Experiments in Aerodynamics," By S. P. Langley. This was included in last year's list of publications.

No. 840. "Life Histories of North American Birds, with special reference to their breeding habits, and eggs; with twelve lithographic plates." By Charles Bendire. Quarto volume of x+446 pages: illustrated with 12 plates of 185 chromo-lithographic figures of birds' eggs.

No. 841. "Smithsonian Contributions to Knowledge. Volume XXVIII." This volume is entirely occupied with the "Life Histories of American Birds," etc., just above described. Agreeably to the established practice of the Institution, a separate edition of 250 copies of the work has been issued as No. 840, for special distribution to those more particularly interested in the subject, the principal edition of 1,000 copies being designed for deposit with the leading scientific societies and public libraries, in continuation of the series of "Contribution" volumes. With the extra title-page and preliminary matter this volume comprises xxi+446 pages, illustrated with 12 chromo-lithographic plates.

No. 842. "The Application of Interference Methods to Spectroscopic Measurements, with five plates." By Albert H. Michelson. Quarto volume of 24 pages; illustrated with 5 plates.

II. SMITHSONIAN MISCELLANEOUS COLLECTIONS.

No. 843. "The Mechanics of the Earth's Atmosphere. A collection of Translations, by Cleveland Abbe." Octavo volume of 324 pages; illustrated with 46 figures.

No. 844. "Smithsonian Meteorological Tables." Octavo volume of lix+262 pages. This work will form the first part of Volume XXXV of the "Miscellaneous Collections," which volume is not yet completed.

No. 849. "Smithsonian Miscellaneous Collections, Volume XXXIV." This volume contains: Article 1, The Toner Lectures. Lecture IX.—Mental Overwork and Premature Disease among Public and Professional Men. By Charles K. Mills, M. D., January, 1885. Article 2, Transactions of the Anthropological Society of Washington, Volume III, November 6, 1883—May 19, 1885, 1886. Article 3, Index to the Literature of Columbian, 1801–1887. By Frank W. Traphagen, PH. D., 1888. Article 4, Bibliography of Astronomy for the year 1887. By William C. Winlock, 1888. Article 5, Bibliography of Chemistry for the year 1887. By H. Carrington Bolton, 1888. Article 6, The Toner Lectures. Lecture X.—A clinical study of the skull. By Harrison Allen, M. D., March, 1890. Article 7, Index to the Literature of Thermodynamics. By Alfred Tuckerman, PH. D., 1890. Article 8, The Correction of Sextants for Errors of Eccentricity and Graduation. By Joseph A. Rogers, 1890. Article 9, Bibliography of the Chemical Influence of Light. By Alfred Tuckerman, PH. D., 1891. Article 10, The Mechanics of the Earth's Atmosphere. A collection

of Translations, by Cleveland Abbe, 1891. The whole forms a volume of v+1054 pages: illustrated with 69 figures.

No. 850. "A Select Bibliography of Chemistry, 1492-1892." By Henry Carrington Bolton. Octavo volume of xiii+1212 pages.

No. 851. "Smithsonian Miscellaneous Collections. Volume XXXVI." This volume consists of a single work: the "Select Bibliography of Chemistry" just above described, 250 copies of the bibliography having been issued as an independent book, and 1,000 copies (with additional title page) as the 36th volume of the "Miscellaneous" series, for libraries and societies. Octavo volume of xviii+1212 pages.

No. 852. Tables of natural signs and co-signs, tangents and co-tangents, together with useful physical constants, etc. Octavo pamphlet of 8 pages.

III.—SMITHSONIAN ANNUAL REPORTS.

No. 845. "Report of S. P. Langley, Secretary of the Smithsonian Institution, for the year ending June 30, 1892," to the Regents of the Institution. Octavo pamphlet of iii+83 pages. Illustrated with 5 figures.

No. 846. "Report of the National Museum, annual report of the Board of Regents of the Smithsonian Institution, showing the operations, expenditures, and condition of the Institution for the year ending June 30, 1890." This volume comprises five sections: I. Report of the assistant secretary of the Smithsonian, G. Brown Goode, in charge of the National Museum, upon the condition and prospect of the Museum; II. Reports of the curators of the National Museum upon the progress of work during the year; III. Papers describing and illustrating the collections in the Museum; IV. Bibliography of publications and papers relating to the Museum during the year; and V. List of accessions to the Museum during the year. The whole forms an octavo volume of xviii+811 pages, illustrated with 163 plates and 99 figures.

No. 848, the Smithsonian report to July 1, 1891, and No. 853, the Museum report to July 1, 1891, have not yet been received from the Public Printer.

IV. REPORTS OF THE BUREAU OF ETHNOLOGY.

No. 847. "Seventh Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1885, 1886:" By J. W. Powell, Director. This volume contains the introductory report of the director (27 pages), together with accompanying papers, to wit: "Indian Linguistic Families of America north of Mexico," by J. W. Powell; "The Midewiwin or 'Grand Medicine Society' of the Ojibwa," by W. J. Hoffman; "The sacred Formulas of the Cherokees," by James Mooney. A royal-octavo volume of xliii+409 pages; illustrated with 39 figures in the text, and 26 plates, of which 2 are maps, and 6 are chromo-lithographs.

Respectfully submitted.

W. B. TAYLOR,
Editor.

MR. S. P. LANGLEY,
Secretary of the Smithsonian Institution.

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